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Collections are invariably made directly from this office for subscriptions, adver tisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[NOTICE.]

Wrinkle Department, American Gas Institute.

WRINKLE DEPARTMENT, AMERICAN GAS INSTITUTE,
OFFICE OF EDITOR, GAS OFFICE BUILDING,
DETROIT MICH, March 12th, 1909.

To the Members, American Gas Institute: All members of the American Gas Institute are earnestly requested to forward contributions for the Wrinkle Department as soon as possible.

Your co-operation determines the success of the Department.

F. L. CROSS, Editor.

BRIEFLY TOLD.

DEATH OF MR. FREDERICK R. PERSONS.—With exceeding regret we are obliged to chronicle the death of Frederick Riley Persons, who passed away, at his home in Toledo, O., the morning of the 1st inst. The funeral services were held there the afternoon of the 4th inst. The honorary pall bearers were: James T. Lynn, Irvin Butterworth, Edward S. Dickey, Carl Asendorf, Thos. B. Guitteau and T. Clive Jones. Next week we propose to give fair mention of his life, which was lengthily and well bound up in the gas industry.

MUNICIPAL PARTICIPATION MADE SOME DIFFERENCE IN THIS INSTANCE.—The gas supply of Louisville, Ky., is carried on under conditions not paralleled quite by those that obtain in any other city in the United States, in so far as our knowledge of the general situation at least goes. The Louisville Gas Company has, as one of its shareholders, the city of Louisville, which owns in fee clear right to a stock in the Gas Company, the par value of which is $925,000, or for every practical purpose an amount equal to one-fourth of the Company's issued or outstanding capital. This ownership entitles the city to two representatives on the Company's Board of Directors, so that whatever is ordered to be done on Company account is done with full cognizance of the city. One would naturally think that such an important ownership as this would cause the city to be very watchful and obstinately averse to the granting of franchises for the operation of opposition plants in the city; but the record shows quite the reverse. It might be well to here note that the electric lighting supply of the city is also largely dominated by the Gas Company, through its control of the shares of electric lighting enterprises originally started by those whose interests were not identical with those of the Gas Company. Further, in time past a charter was granted to the Kentucky Heating Company, under which the latter was empowered originally to distribute natural gas for heating uses only. In respect of the latter, most men who keep *au courant* with gas matters of the day know that the charter thereof has been liberally construed, so liberally, in fact, that at the present time a very, very large percentage of its output consists of manufactured water gas, that is largely used for lighting purposes, through the adventitious aid of mantles. With this active agent in positive competition with the original Company, necessarily the latter's earnings are not so great as would be the case were the field entirely clear; but this invasion, if we may so speak,

LIBRARY OF CONGRESS AUG 9 1909 SMITHSONIAN DEPOSIT.

could be fairly well taken care of. However, when it came to further pronounced opposition in the electric division of its enterprise, the case was different. Some time ago, in line with the latter thought, certain speculators went to the authorities for a franchise, under which it was proposed to operate an independent electric lighting concern. And so well did they plead that Councils sustained their application and ordered the issuance of said franchise. So all was smooth for the seeming success of the looting measure until the document came to Mayor J. F. Grinstead for his signature. His name and lineage are those of a family in Kentucky noted for healthy personality and commercial honor; and, having pondered the case well, at the end of the pondering he refused to affix his signature to the fraud. We report here the text of his veto, the lines of which will easily reveal that the titling to this mention may not be a misnomer. The text of the veto is:

"In 1907 the dividend on Louisville Gas Company stock was 7 per cent., from which the city received $64,750 on its $925,000 of stock. The 1909 dividend is 5 per cent., a reduction of the city's yearly income of $18,500. This reduction of dividend is due to competition from the exercise of franchises recently created, and to the apprehension that there is to be no limit to the future creation of competing franchises.

"This reduction of the city's dividend from gas stock must continue unless the city announces a policy opposed to the indiscriminate creation of franchises for the sale of electricity. Two such franchises have been created within the last two years, but in each case the party for whom the franchise was created had already established a plant, and laid conduits which would have been a loss without a franchise. A stand must be taken against the indiscriminate creation of such franchises, or the value of the city's investment in gas stock and dividends therefrom will be further reduced and eventually destroyed.

"While an electric franchise created by this ordinance may benefit the purchaser thereof and the consumer in a limited territory, it is injurious to the city at large, because any loss in the city's gas stock dividends must be met by increased taxation. The reduction above noted of the city's income from its gas stock, amounting to $18,500 per year, is about one and one-fifth cents per $100 on the assessment of 1909. This loss has been, and any further loss will necessarily be met by increased taxation. Without strong reasons of a general public nature, the city should not add to the burden already borne by the people at large, in the way of taxes.

"It is further my opinion that the upset price of $500 fixed in this ordinance is too small for a franchise of the value of the one thereby created.

"For these reasons I disapprove this ordinance."

CURRENT MENTION.—

WE regret to have to chronicle the death of Mr. D. H. Gildersleeve, formerly prominent in the sales division of the forces of the C. W. Hunt Company, of New York, who passed away the afternoon of the 30th ult.

AT the semi-annual meeting of the Directors in the Portland (Me.) Gas Light Company, held the afternoon of the 27th ult., Mr. William W. Thomas was elected a Director, replacing the late Mr. Charles S. Fobes, and a dividend of 3 per cent. was declared, made payable last Monday. The Board adopted the following minute to the memory of Mr. Fobes:

Resolved, That our late associate maintained in his intercourse with his fellow Directors that dignified courtesy of manner and speech everywhere characteristic of him; and

Resolved, That his service upon the Board evinced the sound and considerate judgment that had established his reputation in the community as a wise counsellor. He possessed to a pre-eminent degree those traits that justly command respect and confidence.

Resolved, That in his death this Company lost a valued adviser and this city an examplar of good citizenship.

THE City Council, of Hastings, Minn., has acceeded to the request of Messrs. Otto Ackerman and H. L. Sumption, both residents of the named place, for a franchise under which they propose to construct and operate a gas works. The grant is to run for 20 years, the maximum selling price is put at $1.75 per 1,000 cubic feet, and it is agreed that the local authorities may order a revision of the schedule at the expiration of each 10-year period. These folks mean business, to be gotten at this season.

THE proprietors of the Company at Kendalville, Ind., are elated over the business which keeps coming in constantly. The consumption on output for July reached 500,000 cubic feet, or over 100,000 cubic feet more than that sent out in June. Consumers to the number of 260 were on the books July 31st, and at least 50 services are in various stages towards the final hooking-up.

"T. G. L.," writing from Minneapolis, Minn., under date of July 30th, forwards the following summary of the deal that is likely to be reached between the authorities and the Gas Company, in connection with the Company's new franchise tenure:

The price or rate to the city on public account, 80 cents per 1,000; the rate to consumers of ordinary type, 85 cents per 1,000; candle power standard to be reduced from 23 to 18; and British thermal unit to rule as to heating value, with 550 heat units as the standard; city to waive right to purchase; authority to examine Company's books and right to order extension of mains to be given to city; price of gas to be arbitrated once in 5 years, if demand for such be made either by the Council or by the Company.

THE Massachusetts Board of Gas and Electric Light Commissioners has given assent to the plan provided for a consolidation of the Cohasset (Mass.) Electric Company with the Electric Light and Power Company of Abington and Rockland. Under the terms of the consolidation the latter concern is to pay $18,000 for the property of the former and to assume all the debts thereof. The Board declares that facilities for furnishing light, heat and power will not be diminished by the amalgamation, and further declares that the consolidation and the plans accepted are altogether consistent with the rights and interest of the public.

THE New Haven (Conn.) Company is extending its main system to and through the outlying hamlets of Augurville and Centerville. There is one sensible practice of the New Haven Company, and that is the speedy action taken by it in respect of asked-for main extensions. If any sort of fair interest on the cost can be figured out, down goes the pipe; the only backing and filling being in connection with the laying thereof.

"P. V.," writing from Fall River, Mass., under date of the 29th ult., incloses the following: "The rank-and-file of the staffs of the Fall River and New Bedford (Mass.) Companies had a joint outing in Lincoln Park, the last Tuesday in July, which was completely enjoyed by each of the 70-odd that shared it. The main attractions were a juicy clambake put up and served in Caterer Whitfield's best style, and an hour or so spent in listening to and beholding the strains and antics of the Lincoln Park Opera Company in their up-to-date rendering of 'Jack-and-the-Beanstalk.' Special cars were provided for the excursionists. Mr. J. Foran, of the New Bedford Company, as Chairman of the Arrangement Committee, was voted a Past Master in the art of providing for the safety, comfort and pleasure of the excursionists, and he and the balance of the Committee as well, richly deserved the vote of appreciation that was tendered them towards the close of the festivities."

AT the annual meeting of the Peoria (Ills.) Gas and Electric Company the officers elected were: H. D. Walbridge, E. G. Schmidt, Walter Barker, F. H. Smith and W. H. Brown; Preident, H. D. Walbridge; Vice-President, E. G. Schmidt; Secretary, W. H. Brown; Treasurer, A. P. Colvin; General Manager, R. S. Wallace.

THE BARTLETT-HAYWARD COMPANY, of Baltimore, are under contract to construct, for the Atlanta (Ga.) Gas Light Company, a 3-lift holder up to retaining 2,000,000 cubic feet. Roughly noted its dimensions are 144 feet in diameter by 176 feet in height.

AT the annual meeting of the Fall River (Mass.) Gas Works Company the officers elected were: Directors, E. S. Webster, E. C. Lee, Jr., Russell Robb, Chas. F. Prichard, Philip Dexter, G. M. Lowe and A. D. Foster; President, Russell Robb; Vice-President, Frederick S. Pratt; Clerk, Alvin Todd; Treasurer, A. Stuart Pratt.

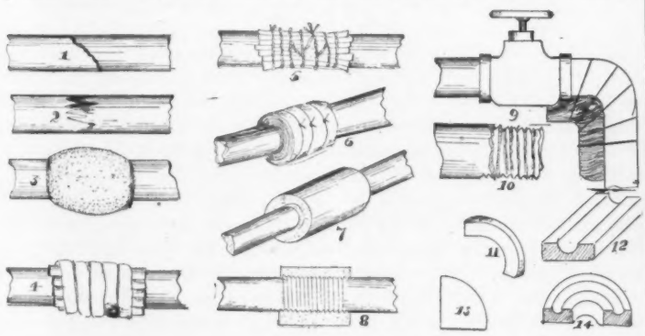
ON the 1st inst. the following schedules of "wholesale" rates for natural gas were put out by the Union Gas and Electric Company, of Cincinnati: First 150,000 cubic feet per month, 30 cents per 1,000; next 100,000, 20 cents; all over 250,000 cubic feet per month, 15 cents; all prices are net.

THE franchise for constructing and operating a gas plant in Water Valley, Miss., has been awarded to Messrs. R. E. Furgueson, of New York. It is stipulated that construction work shall be commenced in 3 months and be completed within 12 months from the signing by the Mayor of the document.

Methodical Emergency Pipe Repairing.

[Communicated by "R."]

Several different methods of quickly repairing leaks in gas pipes may be classed under various heads. There are the shrinking-on descriptions, the splint system, the bonding class, the wrapping method and others, and these classes of emergency pipe repairing were formulated by the automobile people, who found it necessary to utilize emergency repairing schemes for leaks and breaks in gas engine pipes. The gas engine machinists were not long in adopting classifications of pipe wrapping and bonding to make a split or cracked pipe do service until such time as a new joint might be put in. The gas engineering fraternity have adopted some of the types of emergency leak repairs for ordinary house gas pipe service; hence, in the annexed illustrations we show some of the plans utilized for closing gaps and making defective pipes "do" a little time longer. The types of fractures may be placed under two general heads. These are illustrated in Figs. 1 and 2. The break in the pipe may be straight or diagonally across, as in the first drawing; or it may be a ragged, dove-tailed break, as in Fig. 2; or the leak may be due to a pinhole, or to the fact that the pipe having been crushed the collapsing of the same resulted in developing leaky places. Again, the trouble may be at a leaded union, or the packing may be worn or imperfect. The various kinds of defects have to be taken into consideration. Of course, the first move involves placing the ends together, and, if possible, a jacket put on, or other means used to retain the alignment of the broken ends. Clay is used to close the joint if other material is not at hand, and cork wrapping has been employed in cases with good results. You can buy the cork in strips and wind the same about the joint, then bind up with wire. You can bunch up the cork, as in Fig. 3, and wind it,



or you can adopt the splint method, as in Fig. 4, which consists in putting thin pieces of wood about the fracture and binding with tape or cord. The wood pieces are packed with clay or lead, and a wrapping of tape wire adds to the security. Another method of the same class is shown in Fig. 5. Strips of cork can be used advantageously for the splints. Sometimes pieces of leather or rubber are employed.

The common fabrical wrapping system is shown in Fig. 6. The broken ends of the pipe are properly adjusted; then cotton cloth, or strips from an old blanket or gunny sacking, are wound securely around the closed union, thickness after thickness, until a shoulder is made, as in Fig. 6. Then you wind the whole combination with wire to make the combination solid. The process of shrinking on a section of metal sleeve, as in Fig. 7, is used in some shops. Often the piece which is shrunk on consists of a piece of piping the next size larger in diameter than the original. Then, again, a piece of metal is bored out to fit over the pipe ends, when, after the sleeve is on, the pieces are brazed so as to effect a tight joint.

The threaded-end system of uniting two broken ends requires more mechanical work than most men desire to put into an emergency job. The broken ends having first been made square, ends are each cut with a thread and a sleeve similarly threaded is turned on, as shown in Fig. 8. This type of closed fracture is quite permanent in its nature.

In some shops are retained an assortment of wooden and metal forms for utilization as supporting braces or brackets for fractures in curves. In Fig. 9, for example, the turn in the pipe is broken. It being impracticable to set the fracture and retain it in a fixed order without properly formed supports, the supporting brace represented in the shaded part is made of hardwood and applied. The hardwood form should be cut to the shape of the broken union, then the form can be put in position and the piping wired fast to it as illustrated. Of course, there are men who carelessly undertake to make a leaking threaded union secure by simply winding some twine or cotton thread between the cut threads of the pipe end, as shown in Fig. 10. The threads fill up a void and make a loose union more secure by making the threads cling tighter; but it is a slipshod manner of doing work and cannot be encouraged.

Relative to the types of forms of hardwood and metal which may be carried in stock for affording means for gripping on pipe turns, the next Figures exhibit specimens.

Style Fig. 11 can be fitted under a curved pipe and wound into position with wire, cord or tape; Fig. 12 is a common base with groove for the pipe. Fig. 13 shows the block form necessary in giving an underneath support to certain turns of pipes. Then there is the half-turn block, as in Fig. 14, made so that a section of pipe making a turn can be accommodated with a grooved resting base.

Display Advertising Hints from London, Ontario.

London, Ontario, is quite up-to-date in many things, and it is quite certain that one of its notable local institutions, the Gas Company, keeps pace with the growth of the city, which growth is of the solid sort. In the accompanying illustrations Fig. 1 shows a gasholder up

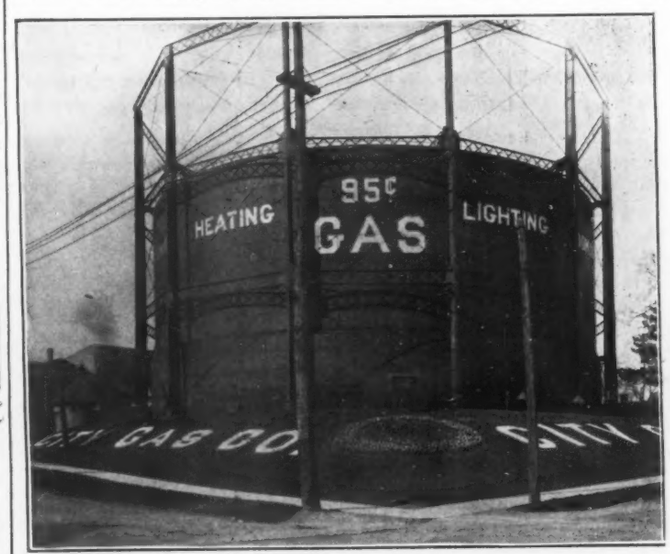


Fig. 1.

Fig. 2.

to retaining 400,000 cubic feet, which is located on the corner of Horton and Ridout streets, directly opposite the gas works proper. The holder is surrounded by a beautiful lawn, carefully graded, sloped and sodded, in the most prominent portion of which is placed a very large flower bed, that in the changing seasons attracts many visitors. The letters spread along the mossy top are brought out in

bold relief at night by means of 10 outdoor gas lamps of the incandescent inverted type. Back of the flower bed is a large flash light sign and well to its right is another illuminated sign, both of which attract much attention. To the left is seen an automatic governor which guarantees to the patrons a steady pressure of 35-tenths. The holder pit is 35 feet deep, and the holder, when fully inflated, rises to an elevation of 60 feet. Its diameter is 100 feet.

Fig 2 illustrates a combined siphon tank and advertising wagon, the photograph thereof having been taken during the spring season, when the flower bed was a dream through a gorgeous display of tulips. Owing to the very bright sun, the lettering on the sign above the tank does not show as it should. It carries the wording:

"Cook With Gas.
Clean, Cheap, Convenient.
Place Your Order Now."

During the summer this wagon is driven around town for advertising purposes, for at that season of the year the coke-drawing horses are not very busy. During the balance of the year it is useful for collecting condensations from the drips without causing any nuisance to the public. We are indebted to Mr. W. J. Alston for these details.

Advertising of a Gas Company.

[Prepared by Mr. Thos. R. Elcock, of Philadelphia, July Number, *Nat. Com. Gas. Assoc. Monthly Bulletin.*]

Not many years ago it was considered almost unnecessary for a gas company to advertise. It was held that there was no competition, that the public goodwill was desired, but not necessary, that they must have light and that the gas would be used whether attention was called to it or not. In short, gas advertised itself. This was before the days of a keen electric competition and before the placing on the market of the countless fuel gas appliances and the enormous use of gas for cooking. Keen, live and active advertising is as necessary to securing new business for a gas company as for any trade. We must not only reach out for new consumers, but must educate our present ones in the uses they make of gas; and, as it is manifestly impossible to exhibit our goods, except in a restricted sense, we must avail ourselves of all the publicity possible, or else to be content to see our per capita consumption decrease.

Advertising, in the restricted sense, means a paid notice in a public print, or a distributed message designed to inform, apprise, describe, or give public notice of goods for sale, with a view to their sale. And in this restricted sense we will deal with advertising in this paper; but we feel it should comprehend more than this. Every transaction of any description carried on with the consumer, or possible consumer, does contain something of the nature of an advertisement. The manner in which your advertisement is received by the public is governed to a very large extent by the treatment accorded to this public by all of your departments.

We see to-day a great deal of purely publicity advertising. Large sums are being spent for expert scribes, and expensive space is being bought, simply to mould public opinion, to remove some unjust antipathy to the local corporation, or to render the public mind receptive to future advertising. This is being well done in places, and, where necessary, should be well done or not done at all. It is not advertising as we are accustomed to consider it, and we will not discuss it here.

It is a debatable question just how much good is gained by advertising in the daily papers. The proposition varies greatly according to local conditions, the character of the papers and the size of population. In a city having a population approximating a million or more, where the newspapers are liable to be from 16 to 20 pages, 4 of which are generally given over to full page displays of the department stores, there is considerable uncertainty as to just how effective your message is and how often it is seen and read. It is often the case that the papers will not guarantee any special position, and you are crowded in where you fit, with associates frequently unsatisfactory and a position decidedly inconspicuous. It is well in such a case to design your space to stand out as much as possible from the conglomeration of display advertising by which it is surrounded. This may be done by confining your copy within narrow limits, employing the remaining space as a white mat, or, by using a distinctive border of a width that would not appreciably diminish your available space, but made of broad, black lines and of a design the character of which would immediately establish your identity. The very small advertisement in the large newspaper is lost, the minimum space to receive any attention is 50 lines deep, across two columns, or 75 lines deep across two columns, which is better.

This condition must differ greatly in a smaller city where the paper is not so overcrowded by advertising space, and where a desired position can be maintained. Newspaper advertising under the latter conditions can be made very effective and of undoubted value.

Newspapers for general advertising *can* be made decidedly valuable. The copy you write for them should follow your display; should be thoroughly in season; should be brief, convincing and dignified. It is unnecessary to seek the bizarre or unusual, and never attempt the humorous style. The fact that the "Gas Company" is saying something carries great weight. Let your ad. show at the first glance who is talking. The reading public is invariably your consuming public, and being such, is interested in any announcement you make, more especially from the fact that your dealings with them have been entirely frank and open, and they can and do rely on what you say. Do not be afraid of expressing yourself too strongly on the merits of your goods. *You* are convinced that there is no other light as good as gas light for every purpose; that nothing else in the world equals a gas range or water heater, and you should have no difficulty in writing of it in a convincing manner. A gas man cannot sound the praises of a tungsten lamp any more than an electric man can write convincingly of the merits of a reflex burner. When you write of gas, talk gas, make your message as strong, clear and concise as possible. Do not attempt evasion. Lay before the public a simple explanation of the article you wish them to know about, give them the reasnos why they should possess it, the saving of labor, of time, and, whenever possible, of expense. All of us would like to know how we can save money.

We, in the business, are a little prone to tire of the continued harping on certain well defined lines of talk on gas, particularly as to gas ranges in reference to the threadbare expressions of "no dust, "no dirt," "no ashes," "no heat," etc. We condemn our ad. containing such matter, putting it down as too aged for use. But these are cardinal points of merit in the appliance, strong talking points, and a woman contemplating the purchase of a range likes to hear of these features, and they are in every sense compelling and convincing. Make your entire copy clear as to such attractions, describe the appliance, picture it, make the public absolutely familiar with it, then reach them directly by personal solicitation and you will find your way well paved. Do not in any ad. forget the three basic principles of satisfaction to the reader—tell definitely how to procure the article, where it can be seen, and give the purchase price. If you sell on term payments, state them.

Newspapar advertising in fact is little more than mere display; you are liable to secure but the hurried attention of the reader and it is, therefore, difficult to render your copy so unerringly strong as to be a final inducement to mould the reader into a prospect. It is at least effective to familiarize the public with your goods, and if it does this it is a good investment. Any display, as such, is in a like manner good advertising. Signs, painted and illuminated, bill boards, posters, street car ads., etc., are all effective if properly followed, and it is in this reinforcement of following up that we secure our most effective weapon and to which we must give our most serious thought. To carry out an effective, direct advertising campaign, your advertising department and your new business department must act as one. Their purposes in this are identical.

There is nothing new in the follow-up system. It partakes purely of a sane business proposition containing nothing of the theatrical or unusual, and on this account is all the more liable to lead to success. There have been many notable failures due to freak advertising.

The most effective follow-up system is based on data secured from the live files kept from your solicitors' returns. The canvass as started is designed to cover your entire territory; as the data is returned it is noted upon the cards, as to the non-use of any particular appliance, or that gas is not used at all. These cards are placed in a separate file, and from this data the mailing of advertising matter is begun.

The mere fact that some certain appliance is not used places that consumer, in our estimation, as a prospect. Possibly a week after the salesman's call the prospect receives by mail an illustrated folder, attached to which is a return postal card. The receipt of this postal, of course, stirs us to immediate action. The silence of the prospect places his or her name in the file for a second call by the salesman. Should the sale then be effected the card is complete; should it not, the prospect receives a personal letter in reference to the appliance, signed by the district sales manager, shortly after the sending of

which the salesman calls again, possibly followed by another personal letter. Of course, care must be taken not to antagonize your prospect. Your salesman can be your guide in this, and should be in touch with the files for his district, so that he may give valuable hints on the nature of the matter to be sent to his prospects. In this way, complete, live data is maintained for every residence in your territory; you reach everyone with matter pertaining to particular conditions, and the appeal is personal and splendidly reinforced by the personal call.

The folder, which is first mailed, should be of as many different descriptions as the trades which you desire to supply. For instance: One covering domestic appliances, another for restaurant appliances, another for blast furnaces, etc.; in every case as a printed part of this folder attach a return postal card.

The personal letter may be done by the multigraph. This machine will give more satisfactory results than print; the latter will not match well with the address, which must be typewritten. There is no great labor or detail necessary to effectively carry out such a campaign, nor is it necessarily expensive. If thoroughly done, it must give results.

It is well to remember that what you do attempt in advertising, do it thoroughly and on as good a scale as possible. Issue one sample of merit, rather than many of an indifferent appearance and hastily compiled. A cheap, trashy looking advertisement will tend to cheapen the opinion of your goods. The printed matter you send your consumers is but an extension of your display, and will be considered by them as such.

The Comparative Values of Various Coatings and Coverings for the Prevention of Soil and Electrolytic Corrosion of Iron Pipe.

[A paper prepared by MR. ROBERT B. HARPER, for the Illinois Gas Association.]

One of the greatest problems now confronting the modern engineer is not so much that of the design or erection, as that of the preservation of the iron or steel structures, which must endure in order to become true monuments to his skill and genius. The three factors—design, erection and preservation—are each and all essential to a metallic structure that possesses both strength and endurance; but, unfortunately, the last and not least important factor has been too often made subservient to the first essentials of design and erection.

The problems relative to the design and erection of iron or steel structures have been more or less successfully mastered by the architect and the engineer, but the same may not be said of the questions concerning preservation. The fact seems that the problems involved in the preservation of iron or steel have not been solved with the same rapidity as those relative to the design or erection of metallic structures. This is, in part, due to the lack of exact knowledge of some of the factors concerned in the corrosion and of the true values of the various so-called preventatives of corrosion. The exact comparative data and knowledge which we have acquired upon these subjects have been very limited in comparison with the known facts regarding the weights, strengths and general properties of the materials considered in the matter of design or erection.

The want of knowledge pertaining to the causes of the corrosion of metallic structures, as well as to the comparative values of preservative coatings or coverings, may be partly due to the fact that the subject of the preservation of underground metallic structures has been almost totally ignored by engineers until recent years. There have been several reasons for this condition of affairs. Among the first which might be mentioned is that of the usual tendency toward radicalism, manifested in the infancy of any industry, as exemplified during the early days of metallic construction, by the apparently unbounded faith of men in the virtues of iron and steel. Another reason which might help us to explain the belated progress of our knowledge of preservation, in comparison with that of design or erection of metallic structures, is one which states that only within the last 70 years has the earth been used for electric circuit purposes, while the use of iron in construction dates back to a more remote period.

It is only within the last 15 or 20 years that the engineering world experienced numerous disasters from the economic and other viewpoints, directly traceable to the use of the earth as part of an electrical circuit. The corrosion of metallic structures by electricity in the form of stray currents has done more to awaken the engineer and scientist to the urgent need of protection for ferric bodies than any other condition of affairs relative to iron or steel structures.

Shortly after the first installation of a trolley electric railway in 1888, Richmond, Va.,[1] or, to be exact, during the years 1891 and 1892, the first cases of underground electrical destruction were manifested in this country in connection with the lead sheaths of underground telephone wires, and with water and gas service pipes near electrical power plants. Since then, so many examples of corrosion of underground metallic structures have been cited, that the engineering profession has been compelled to devote considerable study to the rather neglected question of the corrosion of iron and its prevention. This study has produced a number of theories seeking to explain the various associated phenomena, and has also created a demand for preservative compounds designed for the prevention of rust and of electrolytic corrosion. The demand has been met by a supply of such variegated character that as yet the engineer is "much at sea" in endeavoring to select the most efficient preventative.

Other methods which have been employed to combat the corrosion of metallic structures, but do not involve the use of some coating or covering for the purposes of preservation, will not be considered in this paper.

It is the purpose of the paper to endeavor to show, by actual data and reasonable deductions therefrom, the comparative values of various coatings and coverings for the prevention of soil or electrolytic corrosion of iron pipe, and, furthermore, to give a detailed description of the theories involved and tests made, so that the conditions to which the various preservatives were submitted may be readily understood by those interested in the subject.

In order to more thoroughly comprehend the corrosive conditions which a protective coating or covering must combat, it will be necessary to explain, in more or less detail, the recent and prevailing ideas as to the causes underlying the corrosion of iron.

The Corrosion of Iron.—Numerous attempts have been made to explain the corrosion of iron and its alloys, but not all of the theories advanced have proven broad enough to interpret all of the phenomena which have been carefully observed. To give a complete description of each explanation which has been advanced, relative to the corrosion and rusting of iron, would probably result only in a confusion of ideas concerning this most serious subject. Therefore, it is of only the most important theories bearing on the corrosion of iron, that brief and simple explanations will be made.

The Carbonic Acid Theory.—The carbonic acid theory is the first one worthy of serious consideration, owing to the fact that it has been the generally accepted explanation of rusting and corrosion of iron until recent years. This theory presumes there are three factors in the process of rusting. Namely, carbon dioxide, water and oxygen, and that the action is a cyclical one, as will be shown by the following equations:[2]

(a) $2Fe + 2H_2CO_3 = 2FeCO_3 + 2H_2$.

(b) $2FeCO_3 + 5H_2O + O = 2Fe(OH)_3 + 2H_2CO_3$.

Equation (a) assumes that iron (Fe) is acted upon by water (H_2O) and carbon dioxide (CO_2), combined as carbonic acid (H_2CO_3), with the formation of ferrous carbonate ($FeCO_3$) and the evolution of gaseous hydrogen (H_2).

Equation (b) shows a secondary chemical change taking place between the ferrous carbonate ($FeCO_3$), formed according to equation (a), water (H_2O) and oxygen (O), with the result that ferric hydroxide ($Fe[OH]_3$), or rust is formed and carbonic acid (H_2CO_3) is regenerated, thus giving in the presence of additional iron (Fe) the conditions favorable to a second cycle of chemical changes according to equations (a) and (b).

It is not surprising that the carbonic acid theory has had many advocates when we consider the facts: First, the three factors, carbon dioxide, water and oxygen are almost universally found in the atmosphere or in the earth: Second, it is in accord with the idea that "rust begets rust," and, third, alkaline solutions which neutralize such acids as carbonic, show a tendency to prevent corrosion of iron.

Despite its apparent broadness, the carbonic acid theory of iron corrosion has been shown to be limited in its application to facts by Whitney,[3] Goulding,[4] and others, whose experiments prove that carbon dioxide is not essential to the corrosion or rusting of iron, which may take the place with only water and oxygen present.

The Hydrogen Peroxide Theory.—The hydogen peroxide theory of the rusting or corrosion of iron was recently advanced by Dunstan,

1. "Electrolysis: General, Electrical and Lightning Protection."—AMERICAN GAS LIGHT JOURNAL. Vol. 84, p. 801, H. W. Spang.
2. "Analytical Chemistry," Treadwell & Hall, 1907. p. 92.
3. "Jour. Amer. Chem. Soc.," 1903, Vol. 25, p. 394.
4. "Jour. Chem. Soc.," Lond., 1905. Vol. 87, part 2, p. 1548.

Jowett, and Goulding.[1] They based their explanation upon a well known theory of oxidation introduced to the realm of chemistry as far back as 1881.

According to the hydrogen peroxide theory, the essential factors in the process of rusting are water and oxygen, which act upon iron as follows:

(a) $Fe + O_2 + H_2O = FeO + H_2O_2$.
(b) $2FeO + H_2O_2 = Fe_2O_2(OH)_2 = Fe_2O_3H_2O$.
(c) $Fe + H_2O_2 = FeO + H_2O$.
(d) $2FeO + H_2O_2 = Fe_2O_2(OH)_2 = Fe_2O_3H_2O$.

(Equation (a) shows that iron (Fe), oxygen (O_2), and water (H_2O) act together to form ferrous oxide (FeO) and hydrogen peroxide (H_2O_2.)

Equation (b) assumes that two molecules of the ferrous oxide (FeO) combine with one molecule of hydrogen peroxide (H_2O_2), —formed according to equation (a), with the result that a hydrated ferric oxide ($Fe_2O_3H_2O$) or rust is produced.

Equation (c) assumes that the hydrogen peroxide (H_2O_2),—in excess from the action expressed by equation (a), acts upon iron (Fe) with the formation of ferrous oxide (FeO) and water (H_2O).

Equation (d) is but a repetition of the chemical changes occurring in equation (b).

Although the hydrogen peroxide theory overcomes one of the objections to the carbonic acid theory, in that it does not presume that carbon dioxide is essential to the corrosion or rusting of iron, yet it is not free from criticism. Divers[2] believed the theory to be an inadequate expression of iron corrosion or rusting, because substances such as an alkali or chromic acid, which gradually decompose hydrogen peroxide, do not necessarily prevent its formation. It has also been found that substances such as potassium iodide, potassium permanganate, and other reagents which destroy hydrogen peroxide, actually hasten the corrosion of iron.

The foregoing theories have recently been shown by William H. Walker, Anna M. Cederholm and Leavitt N. Bent,[3] to be untenable in the light of the present known facts upon the rusting or corrosion of iron. Allerton S. Cushman[4] and other experimentalists are inclined to explain the corrosion of iron by electrolytic or electro-chemical processes.

The Electrolytic Theory.—The electrolytic or electro-chemical theory of the corrosion of iron is by far the most complex, and at the same time the most satisfactory explanation yet advanced. While there still remain certain phenomena of corrosion which are more or less clouded in mystery, yet the electro-chemical theory seldom fails to furnish some plausible explanation of these manifestations. Owing to its great adaptability in elucidating the changes which take place during the rusting or corrosion of iron and other metals, and also to the fact that, despite its diversified application, no other theories or facts of great import have been brought forth by scientists to prove it a fallacy, we must accept it as the truth and be guided thereby in our conclusions.

Corrosion, according to the electrolytic theory, assumes the presence of moisture, or some other solvent, upon or surrounding the metal being corroded. In this particular the electro-chemical theory does not differ from the carbonic acid and the hydrogen peroxide theories, and is also in perfect accordance with the well known fact that moisture seems an essential factor in many of our chemical changes. The other agents in the process of iron corrosion, according to the electrolytic theory, are so numerous and varied in character that time and space will not permit of their complete description.

Before entering into the somewhat complex mechanism of the electrolytic, or electro-chemical, corrosion of iron, it would perhaps be best to give some general definitions and explanations of the factors and conditions involved. Although any treatment of the subject must be necessarily long, owing to the intricate actions attending corrosion of iron, an attempt will be made to explain, in the simplest manner possible, the meaning of the terms used, as well as their general application in the theory of corrosion by electro-chemical means.

So closely related to electricity is the electrolytic theory of corrosion that definitions of common electrical terms and laws should be given first, in order that a clear understanding may be had of the explanations which are to follow. In order to enlighten a gas man not thoroughly familiar with the meaning of the electrical nomenclature, definitions will be given and analogies drawn between gas and electricity, as follows:

The electromotive force, or potential tending to drive electricity through a conductor, such as a wire, is somewhat analogous to the pressure on a gas tending to drive it through a pipe.

Positive electricity tends to pass from places of higher to those of lower potential, in much the same manner as the gas tends to pass from regions of higher to those of lower pressure.

The difference of potential, or drop of potential over a resistance, is similar to the drop or fall in pressure due to friction in a gas pipe.

The resistance offered to the passage of electricity by a conductor may be compared to the friction offered by a gas main to the passage of gas.

The unit of quantity of electricity is the coulomb, while that of gas is the cubic foot.

The coulomb is usually defined as that quantity of electricity required for the separation by electrolysis of 1.118 milligrams of silver from a solution of silver salt. It is sometimes called the ampere-second.

The ampere is the unit of electrical current flow, and is somewhat similar to the gas man's cubic foot per hour. The ampere is a flow of one coulomb of electricity per second.

The unit of electrical resistance is the ohm. It is defined as that resistance offered at 0° C. by a column of pure mercury 106.30 centimeters long, with a section of 1 square millimeter.

Electromotive force is measured by a unit known as the volt, while gas pressure is usually measured by the height in inches of water or mercury column which balances the gas pressure. The volt is that electromotive force which produces a current strength of 1 ampere in a conductor having a resistance of 1 ohm.

The watt is the unit of power and is the product of 1 volt times 1 ampere.

Ohm's law states that when an electromotive force E is required to drive an electrical current C through a single conductor of resistance R, then E = CR.

The term current density usually refers to the quotient obtained by dividing the current in amperes by the unit of area of the conductor to or from which current is flowing. This is analogous to the result obtained by dividing the cubic feet of gas passed per hour through a pipe by the area of the cross-section of the main.

An ampere-hour is a term usually applied to 3,600 coulombs or ampere seconds, equivalent to 1 ampere flowing for 3,600 seconds or 1 hour.

"Volta originally separated electrical conductors into a first and second class—the first comprising metals, carbon and certain other good conducting substances occurring in nature, such as the metallic sulphides; the second consisting of all conducting solutions. This distinction is still retained. We describe conductors of the first class as those in which the electric current moves without a simultaneous motion of matter, while conductors of the second class are those in which the transportation of electricity requires a corresponding motion of ponderable material."[1]

Iron and other metals, when immersed in water, show a tendency to go into solution until a state of equilibrium between the metal and the liquid containing the dissolved metal is reached. This tendency of a metal to go into solution is called its solution tension.

This property of metals in the presence of a liquid is analogous to that of a liquid in the presence of a gas. We are all more or less familiar with the fact that a liquid has a vapor tension which tends to drive it into the form of vapor or gas until a state of equilibrium is reached between the liquid and its vapor.

Iron and other metals in solution are subject to a certain force tending to drive the dissolved substance from the more concentrated to the less concentrated solution. This force has been termed osmotic pressure.

Again, an analogy may be drawn between the osmotic pressure, due to a dissolved substance in a liquid and the partial pressure of a vapor, which may be considered to be nothing more or less than a solution of a liquid in a gas. Van't Hoff has shown us that the osmotic pressure of a solution obeys the same general laws as the partial pressure of a vapor or gas. He pointed out the fact that the osmotic pressure of a solution varies directly as the concentration of the dissolved substance, in much the same manner as the partial pressure or vapor of a gas varies with the concentration of the vapor

1. "Jour. Chem Soc.," Lond., 1905: Vol. 84, p. 1584.
2. Proc. Chem. Soc., London, 1905; Vol. 21, p. 251.
3. "The Corrosion of Iron and Steel," Jour. Am. Chem. Soc.; Vol. 29, p. 1251.
4. "The Corrosion of Iron and Steel," U. S. Dept. of Agric. Office of Public Roads Bul. 30.

1. "The Elements of Electrochemistry," by Max Le Blanc. Translated by W. R. Whitney; p. 31.

or gas, in accordance with Boyle's Law, and he also called attention to the similarity between the osmotic pressure of a solution and the partial pressure of a gas, each of which increases at the rate of about 1-273 for every rise of 1° C., in obedience to the Law of Gay-Lussac.

(To be Continued.)

Gas Lighting in the West Indies.[1]

The island of Barbados, the most easterly of the West Indies, is one of the oldest British colonies. It is a little larger than the Isle of Wight, and while chiefly occupied in the production of sugar, it is also much patronized as a health and tourist resort.

Although tropical, the temperature lies usually at about 83°, the extremes being 75° and 85°, and the island is continually fanned by sea breezes. Barbados is the first port of call on the Royal Mail route, only 12 days' sail from Southampton, and, therefore, as the colony has been all British since 1625, it is not surprising to find its people at the present time very much in touch with the mother country. The capital, Bridgetown, is a busy place, and the island, as a whole, very thickly populated. There is a large English-speaking colored population. Labor is plentiful, but suffers in quality by the large drafts of workmen recently shipped to Panama, induced by a higher rate of wages than can be obtained locally.

The gas undertaking was started in 1873, and has passed through many vicissitudes from that date to this, at first in private ownership and latterly under a local limited company. It has had a variety of managers, some local, others English or Canadian. There is a legend that at one time it was a common occurrence for the holder to ground about 8 o'clock in the evening, and for many of the street lamps to remain unlit, but these are matters that can now be relegated to a prehistoric age, and upon which one need not dwell. During later years the concern has been well managed, and much successful lighting has been installed in Bridgetown; but the local Company have not extended their business in line with their opportunities, and, recognizing the necessity of more enterprise than they were prepared to undertake, they have availed themselves of an offer to dispose of the concern to an Fnglish syndicate. To mention that the new Company have retained as their consulting engineers Messrs. Corbet Woodall and Son is sufficient to inspire confidence in the future well-being of the gas supply of Barbados. The present number of consumers in Bridgetown is 373, and as there is no competitive source of lighting other than petroleum in the town, there is every reason to anticipate that this number can be more than doubled, perhaps quadrupled. Extensions of mains are already being carried out, and, if the result is encouraging, the new Company contemplate further extensions, amounting in all to 8 or 10 miles. Steel tubes will be exclusively used for the extended distribution, and some modern additions to the works plant will also be added to bring the undertaking up-to-date and to obtain the most economical working. Extensions and improvements will inevitably be followed by a reduction in the price, which stands now at the high figure of $2.50

Gas in a Tropical Country.—There are some interesting features attending the use of gas as an illuminant in a tropical country. One might be inclined to a feeling of surprise that in such a climate a source of light which in any measure produces heat also would be tolerable. But in this we are judging the tropical colonist by our own standard of closed apartments and unventilated houses, offices, etc. The West Indian practically lives in the open air; the houses are constructed more like cricket pavilions or sanatoria, with as many doors and windows as possible. Churches and halls are delightfully ventilated, every window being entirely open, and a draught of pure fresh air passing through the building. Incidentally, it may be remarked that Barbados is a particularly congenial place to persons, like the writer, who, under any circumstances, or in any climate, object to breathing second-hand atmospheres. It necessarily follows that under these conditions there is not the least heat experienced from the consumption of gas. On the other hand, it is necessary to employ types of incandescent burners which are practically draught-proof. Almost any gas burner is better than an oil lamp, which is apt to be blown out when any wind passes over the chimney. The modern inverted gas lamp is very popular and suitable.

Another important matter arising out of the open air conditions is the necessity of entirely screening all incandescent burners, whether upright or inverted, from the innumerable moths and insects which are attracted to the lights. A burner unprotected at any point by wire gauze or perforated metal will soon be quite choked with these assiduous intruders.

If the prevalence of gas lighting in the West Indies causes any feeling of surprise to the visitor, much more so does the lack of gas cooking stoves. The number of these appliances in the city of Bridgetown, so necessary to the housewife in England during the summer months, could be counted on the fingers of one hand. The reason of this is the cheapness of wood fuel, which can be obtained locally for $3.70 per ton and the custom of leaving the management of the kitchen and cooking arrangements entirely in the hanns of native servants. Without the control exercised by the middle-class housewife at home, it is not surprising to find consumers unwilling to place a gas stove in the hands of their cooks. The cheapness of labor enables a much larger class to keep servants in the West Indies than at home; but there are yet some smaller houses where the manager hopes to place cookers, and by a gradual education, coupled with a reduction in price, to further extend their use in the future.

Another point to note is that incandescent mantles behave differently in a hot climate, or perhaps it may be the tropical conditions coupled with the sea air, which play havoc also with other materials, such as brass and iron. It does not, therefore, follow that the mantle with a reputation at home is the most suitable for abroad. At the same time, there is no difficulty in finding mantles which are suitable.

Other points of minor interest are the extraordinary rise of the gasholder under a tropical sun, and the larger quantity of moisture carried forward into mains and services, necessitating many more siphons than we average in this country.

The output of gas does not vary with the seasons as we are accustomed to here. Such variation as there is lies within each month; there being a considerable drop in consumption during the brilliant moonlight. The sun varies only one hour all the year round. Darkness is complete at 7 during our summer and at 6 during our winter, and twilight lasts only about ½ hour. To the visitor, such short evenings, coupled with brilliant summer weather, are a matter of surprise, but to the gas maker they are business. Coal is obtained from England, and the method of unloading from vessels is at present somewhat antiquated and productive of no little waste. The coal is discharged over the side of the ship into barges or lighters in the bay; by these it is carried to shore and thrown on to the wharf, and thence reloaded into mule carts, which take it to the works. Small sailing vessels can come right into the Careenage and unload direct on to the dock side or into the carts, thus saving much handling and waste; but sailing ships, unfortunately, are getting more and more scarce every year. However, as the gas works are also situated right on the seashore, in Carlisle Bay, it is possible that some scheme, such as, perhaps, an aerial ropeway, may be worth considering in the future for bringing coal direct from the large steamers into the store.

Experiences of the Manager.—The present Manager, Mr. C. L. M. Petersen, has had an interesting and almost unique experience in that capacity. When he took charge of the works, 8 years ago, he had not the least practical knowledge or experience of gas making. As clerk in the office, he was asked to take temporary charge on the death of the previous Manager, and this soon developed into a permanent appointment. By the simple expedient of taking to pieces and cleaning every possible item of his plant and making use of the standard text books, Mr. Petersen educated himself rapidly into practical gas engineering, and coupling this with unusual business capacity and a gift for organization, he has brought the concern up to a considerable state of efficiency. Nevertheless, it goes without saying that in various ways the Engineers of the new Company are able to improve on the general working, and no one welcomes the opportunity of getting into vital touch with English practice more than the Manager himself.

Mr. Petersen tells one or two amusing stories of his early days of management. The first few months were necessarily an anxious period, and it can be readily understood that not even on Sundays was he able to spend much time away from the works. One Sunday evening, however, he snatched an opportunity to attend service at a church not far distant. Before service had very far advanced there came a tap on the shoulder from the verger, accompanied by the following message: "Please, sir, de stoker telephone to say de whole gas works blown up." Whether or not Mr. Petersen ruminated, after the first shock, that, at least, the telephone appeared to have survived the catastrophe, not to speak of the lights in the church, he hastened back to the works to find that a shelf had collapsed in the office, on which were several large bottles of acid left by a previous manager. The fumes from the acid had caused sufficient disturbance to seriously

1. The *Gas World.*

alarm the hypersensitive stoker. On another occasion, Mr. Petersen was summoned to the works on account of mysterious sounds arising in the photometer room. The stokers suggested that it must be the spirit of the late manager; but it proved to be nothing more eerie than the blowing of an experimental governor, which had run short of water.

Looking After the Consumers.—As a practical man, Mr. Petersen's forte is lighting and general attention to consumers. His policy in this most important matter is an example that may well be set before his brethren in the old country. The son of a clergyman, and instinct with the pastoral idea, he pays calls on his consumers, to inquire after their well-being as such, and gives the greatest personal attention to their requirements. There is also a system of complaint cards and a special complaint fitter, who remains at the gas works until 8 o'clock every night. Practically all consumers are on the telephone, and they ring up the works whenever there is any falling off in their light, whether it is due, as they may suppose, to the quality or pressure of gas or to the burner or mantle. That seems strange to an Englishman, who seldom goes beyond a grumble if his gas is bad. All the fittings business is in the hands of the Gas Company in Barbados, and in retailing mantles they have two prices, one for the mantle only and the other for the mantle fixed. This might be a useful hint for other small concerns, as a half-way house to a system of maintenance. Mr. Petersen has put in some excellent installations of incandescent lighting, *e. g.*, the Carnegie Library, which is lighted by 700-candle power Lucas lamps, and some of the large retail stores, which are artistically illuminated with inverted burners. All the places of worship are lighted with gas, including the Cathedral. Occasionally on a Sunday evening the manager drives round and inspects the lighting of all the churches and chapels. This can be easily accomplished without entering, because of the open doors and windows. The street lighting also has Mr. Petersen's best attention, and his habit again is to drive round and inspect every lamp several times a week during hours of lighting. This is not quite so onerous a duty as it might appear, for the lamps are not lit during the brilliant tropical moonlight, which occupies nearly one-half of every month. The new Company is about to carry out a long-cherished scheme of Mr. Petersen's, of reconstructing the whole system of public lighting in Bridgetown city. High power inverted incandescent lamps will probably be used, with additional points and better distribution. The local authorities are co-operating with the Company, with a view to making their town one of the best lighted in the West Indies.

It is noteworthy that the new Company does not propose to send out any skilled men to carry out extensions, with the exception of a retort setter. All the main laying and distribution work will be carried out by Mr. Petersen and his local staff—a photograph of whom

Mr. Petersen and His Local Staff.

is reproduced herewith. The colored workmen are skillful and capable of executing the best class of work. Labor, however, requires much more constant supervision than we are accustomed to give it in this country.

In conclusion, it may be said that the prospects of the island are good. The sugar industry, although somewhat depressed by recent droughts, has largely recovered its old position, since the abolition of the foreign bounties in 1903. It is said that there is no colony in the empire where British capital is so exclusively employed as Barbados, and, therefore, the interests of the island are bound up with those of the mother country. As a port of call, Bridgetown may also look forward to an enhanced position when the Panama Canal provides a thoroughfare into the Pacific. At present that great enterprise is inclined to dislocate the labor problem in the West Indies, but the work is expected to be completed in 1915; and it is impossible to estimate the extent to which this alteration in world route will subsequently benefit the commerce of the neighboring countries.

The Glover and West Vertical Retorts at St. Helens.—Continuous Working with Gravity Charging.[1]

Gas engineers, not only in this country but abroad, have been patiently waiting to learn of the practical development of the vertical retort system at the St. Helens Corporation Gas Works, together with the results of the working. But they have lost nothing by delay, as now it is our pleasure to present to them a system complete, and at work on a practical scale, taking its part—with 7 months' record at its back—in the ordinary daily producing operations, and with routine precision. As a matter of fact, when we remember the period that has been absorbed in the development of other carbonization systems with vertical retorts—every day of which period could be justified—the development of the Glover and West system, including involuntary delays through various uncontrollable causes, has, it must be admitted, been somewhat rapid.

The system is a continuous, and not an intermittent, one; and it had its origin in the patents—known in detail to all who have made a study of vertical retort carbonization—granted to Messrs. Young and Glover. The work of the late Mr. William Young—the former co-patentee—as a pioneer in the successful application of vertical retorts for the purpose of distilling shale, is well within the knowledge of, and is highly esteemed by our readers. The system, however, that has been developed to a practical success at St. Helens, as we are about to describe it, is covered by patents and inventions, in which Mr. John West, of Manchester, is associated with Mr. Samuel Glover. But it must not be thought that features which it was expected would find a place in the St. Helens setting have not been tried. In designing the plant as now erected, Mr. West wisely arranged it with a series of valves and by-pass connections, so that the theories advanced by Messrs. Young and Glover in their original patent could be tested, as well as working with or without the hydraulic main. It was finally proved, after many experiments, that the most satisfactory method was to work with a full retort and dispense with the hydraulic main—having separate valves to each retort and automatically feeding in the coal. Everything was so thoroughly thought out, that all the changes contemplated have been made without letting down the setting since it was started; and the whole plant, we can bear witness, is working regularly and in an excellent manner.

The New Vertical Retort Setting.—In a light steel framed structure—partly filled in with 9-inch brickwork at the lower part, then with 4½-inch brickwork above, the upper panels partially rough boarded in for protective purposes, and with a light galvanized iron roof over the whole—was found the setting of eight vertical retorts whose operations were soon to be admired, for it was at once obvious that, in the installation, continuous working had been reduced to a matter of fine simplicity. But we pause a moment to remark upon the lightness of the structure that has sufficed to protect the setting during the rigor of the winter through which we and it have but lately passed; for it was in October last that the plant was first set to work. It will be a matter for congratulation if, with the coming of the vertical retort system, a cheaper method of building the structure sheltering carbonizing plant becomes the vogue; and there is no reason—as instanced here—why it should not, and capital expense be saved. Some vertical retort constructors go so far as to say that anything more than a light top covering is unnecessary; but Messrs. Glover and West are not of that way of thinking.

The building, however, does not in itself possess the interest of that which it incloses; but we cannot proceed without at once complimenting the Chairman and the members of the St. Helens Corporation Gas Committee upon the completeness given to the installation, and the thoroughness of the test that this has allowed, not only in their own interests, but to the satisfaction of the gas industry at large, the

1. *Journal of Gas Lighting.*

The Setting of Eight Vertical Retorts on the Glover and West System.

professional men of which have for some time had their eyes turned to St. Helens for definite information as to the working of the new process. With the thoroughness of Mr. Samuel Glover, with manufacturers on the large scale as members of his Committee (men who are aware that the value of processes must, to be of use, be tested in a practical way, and on a reliable scale), and with the same life-long principles animating Mr. John West, it has been anticipated that, with the publication of description of structure, there would be something positive at hand. We have that "something" in the finished process and the dependable results.

Running the eye generally over the installation at St. Helens before going into particulars, we see a working combination of eight 20-foot through verticals, complete with coal breaker, elevator, coal hoppers and shoots to the retorts, coke extractors and coke receiving chambers, with patented outlet doors and all the necessary retort bench bracing, staging, staircases, valves, gas and tar mains, governors and other plant. Following the foul main across a short distance of the yard, we see the condenser connections, exhauster, tar and ammoniacal liquor extractor, scrubber and purifiers, tar and liquor tanks. Then, in an adjoining building, is a station meter, a jet photometer, a photometer room fitted with a 10-candle pentane lamp, standard burners, calorimeters, and so forth; and outside there is a 1,000-cubic foot test holder, to which, through the 24 hours, a continuous stream of gas can be passed from the vertical retorts so as to store for testing purposes a representative average of a day's make, instead of taking samples at different periods of the day. We have here, in fact, a miniature gas works with the carbonizing plant, in point of dimensions, on the ordinary working scale. Never indeed has a new carbonizing plant been better equipped to carry practical experiments to a successful and conclusive issue, and to independently test against the working results of the existing system. The vertical retorts and the auxiliary machinery were erected by West's Gas Improvement Company, Limited, of Manchester, who are the sole makers for the Glover and West system.

Some Details of the Setting.—With this hasty glance at the constituent parts of the installation, we may profitably devote a little time to a closer examination of the central feature—the setting—the principles involved in it, together with the methods of operation. The ground space occupied by the 8 retorts in the 1 setting is 17 feet by 13 feet. From ground level to the top of the brickwork of the stack, the height is 33 feet, and the height above this to the top of the coal storage hopper into which the elevator delivers is 18 feet. There is 9 feet of headroom below the retorts, but depending from them are the coke hoppers. So there is no unnecessary space here, other than that essential for the comfortable discharge of the operations associated with the system. The 8 retorts in the setting are of special oval section, 24 inches by 12 inches at the top, expanding to 30 inches by 18 inches at the outlet end. The retorts are 20 feet long. Presently there will be something of interest to say about their heating; for upon the heating of the setting (as, in fact, has been the case in all the details) a good deal of thought has been expended.

Before ascending to the top of the setting, it is observed that the wagons bringing the coal supply to the vertical retorts come from the old coal store and the coal goes through the usual cycle of operations. It is delivered by the wagons into the coal breaker at the foot of the elevator, which then raises it—once a day is sufficient for the present installation—to the storage coal hopper at the top of the setting. The capacity of the elevator and coal breaker is roughly 20 tons an hour.

At the Top of the Setting—Noiseless, Smokeless and Dustless Charging.—Reaching the top of the setting, one can hardly tell that it is at work. There is no mechanical movement of any kind. It is only when the elevator is delivering, for about 2 hours a day, into the coal storage hopper, that there is any noise whatever at the top of the bench, and only about once in 4 hours has the man in charge to ascend to the top to open the valves between the storage and the feeding hoppers; and gas making is then a silent, automatic operation until the exit of the coke at the bottom of the retorts. On top, the brickwork of the setting is only just warm, and the gas outlet pipes are not much hotter. There is, in fact, an infinitesimal loss of heat by radiation here, and the same may be said of all other parts of the setting. It will be seen, as the description proceeds, that the original idea of a moderate free space in the top of the retorts has been sacrificed to simplicity, and that the gas is taken off at the top of the retorts without passing through the coal hopper above.

The coal hopper is capable of holding 20 tons, and as each of the retorts has, under its present conditions of working, been carbonizing about 2½ tons a day, the 20 tons is just sufficient for a day's work. The hopper has 4 conical-shaped extensions from the bottom, which deliver through a hand-worked, gas-tight valve, into the feeding chambers (seen in the photograph of the setting taken before the external framing was bricked in), which are partitioned so that each one feeds into two retorts. The feeding chambers are in direct communication with the retorts, and when they are periodically replenished from the storage hopper (which is the work of only a few minutes) there is really in them a head of coal that will last for 4 hours' feeding. It will be seen from this that the retorts are charged entirely by gravity and without mechanical aid. The coal storing and feeding hoppers, it should be mentioned, are suspended by girders supported on the buckstays, so that the retort stack is entirely relieved of the weight of the hoppers and their contents. At the junction of the ironwork of the feeding hoppers and the top of the brickwork of the setting, provision is made for the upward expansion of the latter in manner somewhat similar to a purifier lute, with a filling of lime or other soft material after expansion has taken place. All this top work is easily examined by the platform running round the setting.

The next thing that arrests notice is the gas outlet pipe that runs laterally from the top of each retort. This outlet is a short, bent pipe, upon which there is a rectangular sealed faced door, 9 inches by 6 inches, so that if any cleaning out is necessary it can be easily and instantly accomplished. Through the center of the door is a small turned plug, about 1¼ inches in diameter, through the opening occupied by which a bar can be inserted to ascertain the relative position of the carbonized and uncarbonized portions of the charges. This short length of outlet pipe (which has a valve attached to it) drops almost immediately—so acting as a descension pipe, and not an ascension pipe—into the foul main, which has a good fall to the condensers. There is no ascension pipe, nor any hydraulic main. By the side of each gas outlet pipe there is another hole, covered by a ball, and perforated by a hole through the center. By turning this ball so that the hole is in a downward direction, a rod can also be used here, if required, to ascertain the positions of the carbonized and uncarbonized portions of the charge. For scurfing purposes the ball is removed entirely, but this is an operation that has been rarely required during the 7 months' working.

Solidity of Structure a Necessity.—With such vertical retort settings as this, one essential to success is that the structure shall be of a substantial character, to withstand the variations of temperature to

which it is exposed in its different sections. The joint designers of the setting attach the greatest importance to the best of material and workmanship being employed in connection with the system; and, under the supervision of Mr. West, West's Gas Improvement Company have put into the setting work of a very strong and substantial character. It is seven months now since the setting started, and the brickwork and ironwork so far as they are capable of examination are in as perfect order to-day as when the plant began work. Every brick in it is made of fireclay; the buckstays, uprights and cross-bracing are all substantial, and they look as though they were fitted in position but yesterday. The old mode of solid construction has been adapted to the most modern mode of carbonization. It pays; for it means longevity.

The Heating of the Setting—Raising the Temperature of the Secondary Air by the Spent Coke.—The producer for the heating of this setting of eight verticals is at one side, and on a platform, about 15 feet from ground level, is seen the charging mouthpiece, covered with a hermetically sealed lid. The charging of the furnace is performed once every four hours with cold coke, and measured so that the consumption is known to a nicety. The fuel account is not more than 12 to 13 per cent. of the coal carbonized, which is notably low. The furnace was seen to be working admirably and everything visible was in excellent condition. The setting, be it remembered, has been at work for seven months, and the bars of the furnace were in the condition one looks for in bars of more recent introduction. Clinkering is performed at intervals varying from 24 to 48 hours, according to the quality of the coke.

Regarding the heating of the retorts—the system is fully protected under the patents of Messrs. Glover and West—temperature regulation is absolutely at will, and any part can be heated precisely as may be required. This is accomplished by a series of combustion chambers from the top to within 3 feet of the bottom of the retorts, and this 3 feet of the botton section is not subjected to the heating gases—being run into the chambers in which the secondary air passes on its way to the regenerators and combustion chambers. Here the secondary air extracts heat from the hot coke that is nearing its point of discharge, so that the air assists in cooling the coke, and the coke performs the useful function of heating the secondary air. Judging of the condition in which coke passes from the setting, and the small amount of radiated heat found at any part, we do not know that we have ever come across a setting in which the heat is so completely confined and utilized as in this one. This has a very appreciable effect in producing the low fuel account.

The method of heating the setting is to have it at a higher heat at the top than at the bottom; and this is readily accomplished through the distinct combustion chambers provided. There is a division wall between the two rows of retorts. From a common channel at the side of the setting there is a porthole giving entrance to the producer gases in each pair of combustion chambers. On either side of this gas inlet is a porthole for the admission of the heated secondary air. Combustion takes place on each side of the division wall, and there is free travel round the retorts—the waste gases passing out into a common flue and on to the next pair of chambers. With the accretion of the waste gases, and the supplementing of the secondary air in the successive chambers, the graduated heating of the retorts from top to bottom is secured by this patented arrangement. An inspection through the sight holes provided at the side of the setting shows a gradual rise of temperature upwards, chamber by chamber, until in the top chamber heating is seen that has been the admiration of all who have so far had an opportunity of making an inspection.

The Extraction of the Coke.—The patentees of this new system of carbonizing in vertical retorts have more than one system of extracting the spent charges from the retorts. But on the present occasion it will be sufficient to refer to the one witnessed in successful operation at St. Helens. Beneath the retorts is the coke receiving hopper, partitioned into four separate chambers, so that two retorts deliver into a single chamber. Each chamber has a curved swing cover over the bottom outlets, and this serves as a container for a shallow water seal, which is replenished by a water tap on the side of the hopper after every discharge of the coke. At the bottom of each pair of retorts is a plate, which practically forms a base for the charges. On the top of this plate is a "wiper," or rotary arm, which slowly revolves—making only one revolution in from 15 to 20 minutes—and pushes the coke off the plate into the receiving hopper below. At each of the four corners of the hopper is a spindle by which the "wiper" is revolved. Each pair of spindles is operated by arms connected with a reciprocating bar, which, in turn, is operated through reducing gear—the motive power being provided by one of West's Gas Improvement Company's engines in an adjoining engine-room. The speed can be varied at will, according to the coal being carbonized. Hence it follows that the speed of carbonization and the quantity of coal passed through the retorts in twenty-four hours are completely governed by the rate at which the mechanical discharge is effected. If the coal is wet, or, from any other cause, wants more burning off, the means of extraction can be regulated to meet the conditions. At the present time, as previously stated, 20 tons of coal are being passed through the eight retorts per day, so that each retort is carbonizing 2½ tons. Thus the travel of the coal from top to bottom takes about 12½ hours. The coke is removed from the receiving chambers about every half-hour at present; and it is carefully weighed each time—one discharge from four retorts that was personally examined weighing 6.1 cwt.

The operation of discharging the retorts is interesting to watch. From this small installation the coke is barrowed; but for the larger installation in prospect coke conveyors will be used. The water sealed covers of the coke receiving hoppers are operated by a lever worked by hand. At the first short pull at the lever, the water in the curved lid escapes, and as the lever is fully pulled out the coke discharges into the barrows in excellent condition - solid, large, dry and bright, and practically without breeze. The local manufacturers are already learning the value of this coke as compared with the ordinary, and they willingly pay 63 cents per ton more for it. Practically no quenching at all is required. Such indeed have been the advantages of the Glover and West system of heating the secondary air by the outgoing coke that the coke only occasionally requires the addition of a little water for the purpose of quenching it, and consequently the absorption of the heat of the coke by the secondary air results in considerable economy in fuel. Therefore, this forms a very valuable part of the installation.

The Question of Steam Admission.—There is one question that may be raised in the minds of readers, and that is as to whether, with the water seal at the bottom of the coke receiving hopper, there is any appreciable amount of steam admitted to the retort. There is not, and a moment's consideration will prove it. When the first droppings from the retort have made a bed at the lower part of the coke receiving hopper, the water is completely insulated, as it were, from the subsequent discharges. As a matter of fact, the patentees have, after mature consideration, abandoned all idea of the admission of steam, for several reasons, which, summed up, have convinced them that from it there is no material advantage to be gained, but rather harm.

Wear and Tear.—As to the question of wear and tear, after only seven months working it is impossible to speak with any amount of positiveness. But the length of time is sufficient to enable the patentees to say that the item of wear and tear will be on a low scale. Just consider the conditions with this process of continuous working. The charging is in small quantities by gravity. There is nothing to cause trouble. The retort is not subject to any violence or rapid fluctuations of condition through the admission of heavy cold charges and the withdrawal of highly heated ones. The travel of the charge into and out of the retort is as gentle as it possibly can be. Mechanical operation is limited to the 20-minute revolution of the "wiper" extracting the coke at the bottom of the retort. The retorts have only required scurfing twice since they were started. These are all points in favor of a low wear and tear account.

Labor.—At the present time, it is impossible to say much about the question of labor. On this setting of eight retorts, there is one stoker per shift, at $1.37 per shift, whose duty is to look after the driving engine, exhauster, and the whole of the plant, the feeding of the coals to the retorts and coke to the furnaces, and the removal, weighing and tipping of the coke in the coke yard. There are also two laborers during one shift, at 90 cents each per shift, to unload the railway waggons, elevate the coal into the top hoppers and attend to the weighing and elevating of the coke for the furnaces. The cost of the three stokers and two laborers amounts to $6.50 per day, or 29 cents per ton of coal carbonized, and this shows a considerable reduction as compared with the cost of working in the horizontal retort house. These men are only partially occupied and could attend to at least two settings of retorts per shift, which would reduce the cost by one-half. During the whole of the experiments, the coke produced and that required for the furnaces has been carefully weighed, so that, in the ordinary way of working the operations in vogue at present would be considerably reduced. Mr. West estimates that, with a moderate sized installation, the labor costs would be from 12 cents to 18 cents per ton according to locality.

All Tests on an Independent Plant.—Before referring to the results from tests made on the plant in the course of ordinary working, both by the contractors' engineers and chemists, and independently by Dr. Harold G. Colman, over a period of some days with great comprehensiveness, we will just take a glance at the auxiliary plant which gives to this setting the advantage, in the trials and tests, of being a complete gas manufacturing unit. When treating of the plant at the top of the setting, we traced the course of the gas from the head of the retorts through the short descension pipe into the 10-inch foul main. The plan shows the disposition of the auxiliary plant. All the connections, it will be seen, are 10 inch. The 10-inch foul main runs across the yard—connecting up first with a retort house governor (fitted with a by-pass), on to the 10-inch vertical condensers, only part of which, however, are in use. At the bottom of these condensers beautiful thin tar—that is to say, beautiful as tar goes – of a brownish appearance, is seen escaping; and then we come to the exhauster. In passing, it is noticed that there are gauges situated at different parts all through the plant - at the top of the retorts and at the bottom, and interspersed among this external condensing and purifying plant, and, making allowance for friction, it is remarkable how level the pressures are maintained. Then the gas passes through a tar extractor and ammoniacal liquor scrubber. All the condensed tar and liquor from all parts of the plant run into a common 8-foot diameter tank above ground, where it is measured before being run off into the ordinary works' tar and liquor well. From the scrubber the gas passes to the purifier, where it is treated by oxide of iron and not by lime as is that from the horizontal retorts. The gas is registered by a separate station meter (which has been certified by the makers) before passing to the common storage of the works. As already stated, a special photometer and testing room has been fitted up, and a 1,000 cubic foot test holder is available for the tests, into which a continuous sample of the gas can be drawn throughout the 24 hours. Thus, it will be remarked, everything is distinct from the ordinary working; everything can be got at; everything can be completely measured and tested at will. And there can be no question about anything.

(To be Continued.)

The Effects of Short Circuits on Watt-Hour Meters.

[Graduation Thesis prepared by A. L. Goetz, B.S., in E.E., '08, College of Applied Science, Iowa State University.]

The watt-hour meter is an instrument for summing up the total energy delivered to a circuit. It is used chiefly as a meter for recording the amount of energy delivered to a customer by a central station.

Nearly all the modern watt-hour meters consist of a small electric motor, the armature and field coils of which constitute an electro-dynamometer. Referring to Fig. 1, the terminals *AA* are connected

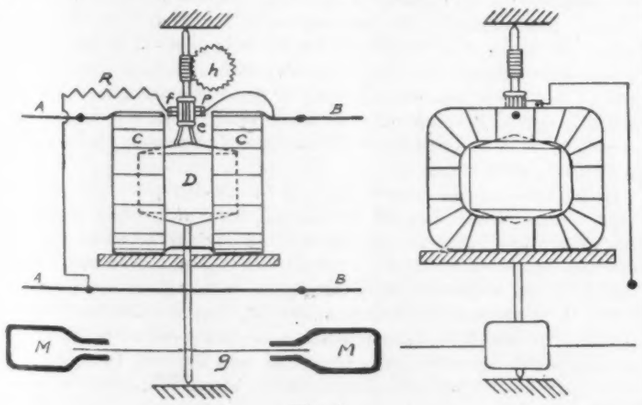


Fig. 1.

to the supply mains, the terminals *BB* are connected to the receiving circuit, *CC* are the series field coils of the motor, *D* the armature, and *R* is a non-inductive resistance in series with the armature *D*. Current is led into the rotating armature by means of the metal brushes *ff*, which rub very lightly upon a small commutator *e*. The armature is mounted upon a vertical spindle, the bearings of which are as nearly frictionless as possible, and the opposition to rotation is due to the electro-magnetic drag of the permanent steel magnets *MM* upon the aluminum disk *g* which is attached to the armature spindle and rotates between the poles of the permanent magnets. From this spindle, by means of a worm and gear *h*, the recording dials are operated, thus making the instrument self-recording.

The constancy of calibration depends, among other things, upon the permanence of the magnetism in these drag magnets. If they should increase in magnetic strength, their torque per unit rate of disk rotation would likewise increase, and the meter would tend to under register. If, on the contrary, they should be weakened magnetically, their torque upon the disk rotating at a given speed would be diminished and the meter would speed up accordingly, and over-indicate. In the first place the error would go against the company furnishing the power; in the second case, the error goes against the consumer.

It is well known to central station men that short circuits on the consumers' mains are liable to affect the calibration of a meter. This short circuit causes a sudden great excess of current to pass through the series of coils of the motor meter, the series coils becoming momentary powerful electro-magnets that are capable of disturbing the magnetic condition of the permanent drag magnets. While short circuits are known to affect the calibration of the meter, it has been generally supposed that if the axis of the permanent stood at right angles to the magnetic axis of the series coils the permanent magnets were protected. That is, if a short circuit occurred on the circuit to which the meter is connected, the magnetic flow would have a minimum effect on the permanent magnets. Manufacturers have taken out patents on this, claiming that the right angle arrangement gave complete protection. Referring to Figs. 2 and 3, Fig. 2 is what is known as the right angle arrangement and Fig. 3 the arrangement

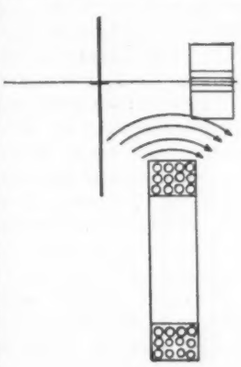


Fig. 2.

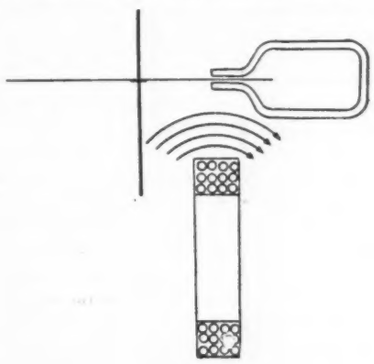


Fig. 3.

where the magnetic axis of the series coil and the axis of the permanent magnets are parallel.

Reports of experiments are recorded wherein experimenters fitted an actual watt-hour meter with auxiliary coil, similar to the series coil of the meter; through these coils a heavy current was sent, such as would be produced by a short circuit on the load mains; this was for various angular positions from right angles to parallel and the effect on the meter calibration was determined by noting if there was any increase or decrease in the rotative speed.

Their conclusions were that whenever a magnet such as is used in meter construction is subjected to a sudden blow from an intense field at right angles to the lines along which the molecules have arranged themselves when magnetized, the result is always a demagnetization of the permanent magnets; due to the fact that the flux passes through the magnet at right angles to the direction of the molecular alignment, only forces are exerted which tend to destroy the arrangement of the molecules with a resulting reduction in the strength of the magnet. In the case where the magnetic blow comes from a field which is parallel to the axis of the magnets, there is an increase in the strength of the magnet. Here each of the two limbs of the magnet is traversed by the flux emanating from the series coils, but the direction of the flux is different in the two portions of the magnet as compared with the sense of the moleular alignment. In one limb the tendency is to strengthen the grouping of the molecules and in the other to destroy it, but as steel exhibits unequal changes in magnetic strength for equal and opposite magnetizing forces, the larger change being in the direction of the initial set, there is accordingly a gain in the strength of the magnet.

The experiments might lead to erroneous conclusions as regards the changes in the strength of the permanent magnets as the method used to detect any change was by noting any increase or decrease in rotative speed of the meter, which is no positive proof of any change in the condition of the permanent magnets.

In order to study what effects such short circuits have upon the permanent magnets, an apparatus was constructed upon which two coils, similar to the series coils of a watt-hour meter, were mounted; the terminals were brought to binding posts through a fuse gap. Above the coils was mounted a watt-meter magnet upon a swivel so that its angular position, with respect to the magnetic axis of the coils, could be varied from a right angle position to one where the axis of coil and magnet were parallel.

The strength of the magnet was measured by the "test coil" method. In this method a coil of wire, the terminals of which are connected to a ballistric galvanometer, is slipped over one limb of the magnet and then quickly withdrawn, the resulting deflection on the galvanometer scale being noted. By this means any change in the strength of the magnet could be detected by the change in the throw of the galvanometer.

A drag magnet was taken from a watt hour meter and its normal strength determined by the above method. The coil terminals were then connected so that by the closing of a switch they could be connected to the direct current supply mains through automatic circuit breakers. The switch was then closed and the circuit breakers thrown; the strength of the magnet was then determined by noting its throw. This operation was repeated for both the right angle and parallel positions of the magnet with the circuit breakers set to throw at 75 amperes. Measurements then failed to show any change in the strength of the magnets with a possible exception of a very slight increase in strength for the parallel position.

It was suggested that the permanency of the magnets might be due to their being magnetically aged and consequently magnetic set. To assertain what effect short-circuits would have on magnets which had not thus been aged, some meter magnets, which were unmagnetized, were procured from a watt-meter manufacturer. These were then magnetized by means of an electro-magnet and were then subjected to the same short-circuiting process as was done in the first case. These measurements, which are shown in Plate 1, gave results showing a change in the strength of the magnet from 1.7 per cent decrease for the right-angle arrangement to an increase of 2.5 per cent for the parallel position. Plate 2 is a curve showing the relation between angular positions of the coil and changes of strength in per cent.

The conclusions drawn from these experiments were, that while short circuits such as occur on the load side of a watt-meter may effect the calibration of the meter, the changes that it causes in the strength of the permanent magnets, especially when the distance between the coils and the magnets is inclined to be large and the magnet aged, are too small to cause any appreciable change in the calibration of the meter.

Plate 1.

Angular Distance Between Axis of Coil and Magnet.	Galvanometer throw Before Short-Circuit Occurred.	Galvanometer throw After Short-Circuit Occurred.	Change in Strength in Per Cent.
	12.2	12	
90°	12.2	12	1.7 per cent decrease.
	12.2	12	
	12.15	12	
60°	12.15	12	1.2 per cent decrease.
	12.15	12	
	12.1	12.3	
30°	12.15	12.25	1.3 per cent increase.
	12.1	12.25	
	12.3	12.6	
0°	12.3	12.6	2.5 per cent increase.
	12.3	12.65	

Application of Reinforced Concrete Piling in Foundations, Station "C," Oakland, Cal., of the Pacific Gas and Electric Company.[1]

[By Mr. H. C. Vensano, of the Engineering and Construction Department.]

In connection with the construction of the new 9,000 kw. steam turbine station for the Pacific Gas and Electric Company, recently constructed at First and Grove streets, Oakland, the use of reinforced concrete piling was decided upon as proper for the foundations of the buildings and machines. While the use of concrete piling is not new, and such piles had been used considerably in Europe and the East, at the present time very few have been driven in this part of the country. Therefore, the conditions which lead to their adoption may be of interest.

The building for which foundations were to be provided was to be 80 feet by 155 feet over all, divided into two sections; one 43 feet by 80 feet, 62 feet in height, in which were to be located the 9,000 kw. turbine and auxiliaries, and to be equipped with a 40-ton bridge crane; the other section, 80 feet by 122 feet and 41 feet in height, in which were to be installed the boilers, eight in number. (Fig. 1.)

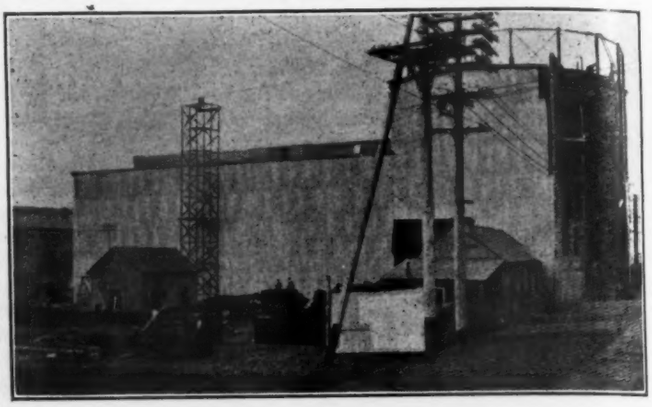


Fig. 1.—Station "C," Oakland, Partially Completed.

This building was to have a steel framing and concrete roof. The walls were to be constructed of corrugated steel, but the foundations were to be designed to allow for the substitution of 6-inch reinforced concrete curtain walls at a future time.

The property upon which this building was to be constructed is located upon the Oakland Estuary. The natural foundation in this location is a fill made a number of years ago upon the mud of the estuary bank. This layer of fill, consisting chiefly of cinders and ashes mixed with some earthy material, is about 6 feet thick and quite compact. Underlying this is a foot or two of black mud, then about 3 feet or more of a sandy blue clay, very wet and very soft. This is, in fact, a "quick" mud which flows into and fills any excavation made in it. Beneath this clay or mud is a yellow clay, regarded locally as the hardpan, and although quite wet on top, is very compact. Wooden piles driven therein within a short distance of the new building site are claimed by the contractors who performed the work to have been driven practically to refusal at a depth of about 25 feet below the surface of the fill.

On the north end of the proposed building the hardpan lay from 8 to 10 feet, and at the south end from 12 to 14 feet below the surface. From the general character of this material it was the writer's opinion that it could have been safely loaded with about 3 tons per square foot. In fact, older buildings at present standing, whose foundations have been carried on this stratum, are loaded to about this amount.

In designing the foundations, there were three possible methods to be considered, *i. e.*, to carry all the foundations to hardpan; to use wooden piles capped with concrete below the surface of the ground water; or to use concrete piles with concrete caps. The first method would have necessitated concrete piers and foundations varying from 8 to 14 feet deep, besides requiring expensive excavation and sheet piling work in keeping out the quick mud. This was at once discarded when considered from the standpoint of economy as compared with the other methods.

In considering the second method of wooden piles and concrete caps, it was found that the permanent level of ground water was from 6 to 7 feet below the top of the filled surface, or about 8 feet below the proposed finished building floor. Concrete foundations 8 feet deep, and supported on wooden piles, would then be required.

The third method, involving the use of concrete piles, would allow the foundations to be made as shallow as consistent with strength regardless of the ground water level. It was decided, therefore, that with proper reinforcement capping piers about 27 inches deep could be used.

The last two methods were then compared from an economical standpoint. As finally designed, 180 concrete piles were used in all. This included all piling, not only for the building, but also for the turbine and boilers. These piles were designed to support a maximum dead load of about 20 tons. While this load is actually carried by the piles of the boiler foundation at the present time, those supporting the building are, in general, loaded only to about 12 tons, due to the fact, as previously stated, that the building is at present covered with corrugated steel, though ultimately to have concrete walls.[45] When these walls are finally constructed the piles will be

1. "Pacific Gas and Electric Magazine."

loaded as above stated. Those beneath the moving turbine, considered as a live load, were loaded to 12 tons.

The capping of these concrete piles, about 27 inches deep, would require an excavation of only about 15 inches, thus leaving the fill in a practically undisturbed condition. This fill having been tested with loads of 2 tons per square foot, it was decided that 1,000 pounds per square foot could be safely carried by it. In the case of the turbine and boilers, where the piles were rather far apart (not closer than 3 to 4 foot centers), this pressure was allowed upon the fill and deducted from the load to be carried by the piles. For the building, the piles were assumed to carry the entire weight. For purposes of estimating, the allowable load on wooden piles was assumed at 15 tons for dead and 12 tons for turbine loads. In this case, as the fill would have to be entirely excavated to the mud line in order to leave the piles low enough that they might be permanently moist, nothing could be allowed for the value of the soil in bearing and it was necessary to figure the piles as carrying the entire load.

Under these conditions, it was found that while 180 concrete piles were required, the number of wooden ones necessary would have been 347. This large increase is due not only to the somewhat smaller figured carrying capacity of the wooden pile, but in a large measure to the additional weight of concrete in the foundation. The additional amount of concrete required to extend the piers an added depth of 6 feet, and to provide in a few instances for larger cappings to cover the additional piles, amounted to 575 cubic yards. As a comparative cost, we then had:

Cost of concrete piles in place (180 at $41.10)	$7,400
Cost of reinforcement in place (necessary for piers, etc., in connection with concrete piling)	700
Total	$8,100
Estimated cost of wooden piles—347 at $11 in place	$3,817
Estimated cost of additional concrete at $10 per cubic yard (including forms)	5,750
Estimated additional excavation, 700 cubic yards at 50 cents	350
Total	$9,917

These figures show a saving of $1,817 in favor of the concrete piles, or about 20 per cent. of the total cost. The cost of concrete as estimated compares very favorably with the actual cost of the material as actually placed. The price of $11 per wooden pile is a figure based on prices quoted by contractors for this class of work, so that the actual saving was very nearly as indicated. This cost of the concrete piles was also high, due to unfavorable conditions for their use. Under favorable circumstances, I believe a further saving of $1,000 or more could have been made. The conditions producing this result were as follows:

The construction of this plant was undertaken on very short notice, due to the failure of certain sources of power upon which the Pacific Gas and Electric Company had been relying. The work was, therefore, undertaken the latter part of July with the intention of having the plant in operation by December, if possible, to provide for the heavy holiday and winter lighting loads. This, of course, required every effort to be made in the line of speed. Wooden pile foundations would have been the quickest form of construction. This type would have been used in spite of the additional cost had it been found possible to obtain a quicker delivery upon the steel frame of the building. As the obtaining of structural steel is, in general, a governing feature as regards time in the construction of such buildings, this was the first item looked into. It was found that 50 working days was the best guaranteed delivery obtainable. This allowed about two calendar months for construction of the foundations. It was estimated that 10 days would be ample for pouring the concrete after the last pile was in place. Allowing 10 days for hauling and driving, and 10 days for obtaining materials and fabricating the piles, left but 30 days for the setting of the concrete before driving.

Mr. L. J. Mensch, M. Am. Soc. C.E., because of his experience, was called upon for advice, and it was decided that the piles could be driven at this early age provided proper precautions were used. Mr. Mensch was given the load to be carried per pile, and he, in conjunction with the Company's engineers, designed and agreed to furnish and drive them at the price noted under the comparative estimate. He was to be responsible for all piles destroyed in driving, and to be prepared to furnish such extra ones on this account as might be needed.

They were to be from 22 feet to 25 feet long, 12 inches square in cross section, reinforced with four 1-inch round or four ¾-inch twisted rods spirally wrapped with No. 5 wire with 3-inch pitch and extra wrapping at the point and top.

A mixture of concrete in the proportions of one part cement to one part sand and two parts crushed rock was decided upon and used. This rich mixture, together with the risk the contractor assumed by being responsible for all piles destroyed in driving, necessarily resulted in an increased cost. Had there been sufficient time (from 60 to 75 days for setting) to allow for the use of a 1:2:4 concrete mixture, the cost would probably have been $1000 or $1200 less. As an actual fact, only three piles were broken in driving, and at least one of these was defective before being placed under the hammer.

As time progressed, it was found that the structural steel would not be delivered as guaranteed, so that the starting of the driving was not begun until 40 days from the time that the first pile was poured, instead of 30 days as planned.

A steam hammer was employed for driving and, to the writer's knowledge, these were the first reinforced concrete piles to be driven on this Coast by this method. Fig. 2 shows a pile under the hammer.

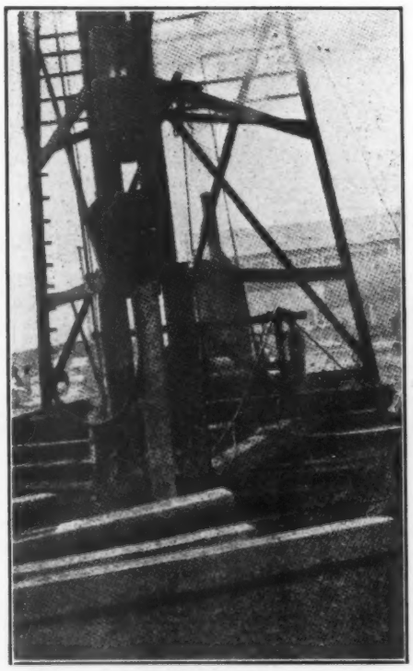


Fig. 2.—A Concrete Pile Under the Hammer.

They were struck about 200 blows on an average, the final penetration being from ¼ to ½ inch.

As a protection to the head of the pile during driving, a special casing, constructed of sheet steel, was bolted around it. This casing was made 16 inches by 16 inches in cross-section and wedges were driven between it and the pile. In this way a closer joint was obtained than by attempting to design a close-fitting cap to use without wedges. It was made twenty-four inches long and was arranged so as to project 12 inches above the top of the pile. In the space so left, sand was placed and upon this a steel block to directly receive the impact of the hammer. While this sand cushion worked satisfactorily, it was found later on that wooden plates could be substituted therefor with equally good results and with a slight saving of time. The accompanying cut, Fig. 3, shows the cap in place ready to receive the sand.

A test pile 20 feet long was first put down. Its final penetration was 4/10 inches. The test load was placed on it during the two succeeding days and the results of the test are tabulated elsewhere.

The load consisted of sacked cement (Fig. 4 shows pile carrying test load). Twenty-five tons were applied the first day, when the noted settlement was 0.26 inches. This increased over night to about 0.31 inches. The next day the load was increased to 35 tons, when the settlement noted was 0.40 inches. After 1 hour's time had elapsed this had not increased. More load was then applied. At 43 tons the pile began to settle quite rapidly and at 49 tons the settlement was 1.75 inches. This load was left on over night and the following morning the settlement was 2.62 inches. Upon removal of the load the pile rose .20 inches. This was taken to have been the elastic distortion of the material in the pile itself and was very nearly equal to

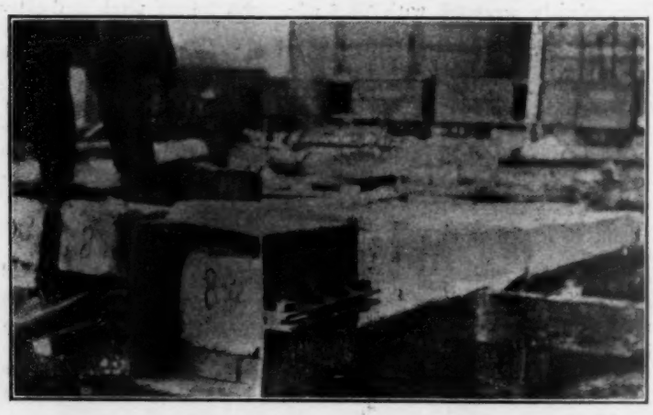


Fig. 3.—Pile Cap.

Fig. 4.—Pile Carrying Test Load.

the entire settlement noted at 25 tons. It is the opinion of the writer that 35 tones was about the ultimate load of the pile.

Fig. 5.

Since the completion of the station, no apparent settlement has taken place in any of these foundations, and the piles seem to be doing their part efficiently. It may be noted in conclusion that the fill gives very little lateral support to the upper 10 feet or so of the piles. The turbine when running at full load, however, produces scarcely any vibration in its foundation. It is very doubtful if wooden piles, even with their increased number, would have produced as rigid a foundation.

Test of Pile.—Age, 40 days; length, 20 feet; number of blows to drive, 175.; penetration under last blow, 0.4 inch. Driven with steam hammer. Weight of hammer, 5,000 pounds. Fall, 42 inches.

Date.	Time.	Load. Tons.	Elevation Top of Pile.	Settlement in Feet.	Settlement in Inches.
Sept. 9	10:30 A.M.	None	2.525′	....	....
Sept. 9	10:45 A.M.	16.0	2.525′	....	..
Sept. 9	12:15 P.M.	25.5	2.508′	.017′	0.20″
Sept. 10	8:00 A.M.	25.5	2.499′	.026′	0.31″
Sept. 10	9:20 A.M.	35.0	2.491′	.034′	0.41″
Sept. 10	10:30 A.M.	43.0	2.470′	.055′	0.66″
Sept. 10	11:20 A.M.	49.0	2.378′	.147′	1.76″
Sept. 11	8:00 A.M.	49.0	2.308′	.217′	2.60″
Sept. 11	8:30 A.M.	35.0	2.303′	.222′	2.66″
Sept. 11	9:30 A.M.	3.0	2.319′	.206′	2.47″
Sept. 11	10:00 A.M.	None	2.319′	....	....

Items of Interest
FROM VARIOUS LOCALITIES.

THAT clever instructress in the art of domestic science, Mrs. Helen Armstrong, has favored us with a copy of the latest edition of a compilation known to cooks and gourmets under the title of "Some More Good Things to Eat." The volume is appropriately terminated by a series of "Helpful Hints in Regulating the Gas Oven." The book is for sale; write to her for prices, sending your inquiries to her at 159 West 66th street, Chicago.

MR. CARL STEINWEDELL, the younger son of that grand old gas man, and brother of our own "Will." Steinwedell, has been appointed Superintendent of the Frontenac Gas Company, of Quebec, Canada. That he may go on to complete success in his new field of duty is the hope—yes, and the belief—of all who know him.

MR. J. H. M. YOUNG, writing to us from London, Ont., calls attention to the fact that it does not matter how much insurance you have on your buildings in that section of the country, you cannot collect a penny from the insurance companies, if you keep ever so small a quantity of gasoline on your premises without special insurance, which special will increase your regular insurance rate in the sum of 25 per cent. A case now (that of the Equity Insurance Company against Thompson, of New Liskeard) bears on this point. Thompson owned a drug store, and his manager was a man named Post. The latter bought a gasoline stove and set it up in the backroom of the shop without having informed anyone about the purchase. In a short time the stove exploded, setting fire to the shop, which was badly damaged. The premises were insured but the Company declined to pay the loss, setting up as defense the clause in the policy relating to gasoline, etc.

MR. H. L. GRIGGS, Sales Manager of the Bristol Company, Waterbury, Conn., informs us that the Company last month established a branch office in Pittsburgh, Pa., in the Frick Building Annex. The Company will place an expert in charge of this office, who will be glad to co-operate with its patrons in the adjoining districts of Newcastle, Youngstown, Wheeling, Scottdale, Johnstown and Oil City, in which places are scores of huge shops and mills, given over to manufactures of iron and steel, in which operations the true and speedy determination of temperatures of the higher order is a necessity.

MESSRS. H. M. BYLLESBY & CO., of Chicago, inform us that, in order to meet the imperative requirements for space resulting from the merging of the American Trust and Savings Bank and the Continental National Bank, they vacated the 5th floor of the American Trust Building the first inst., and thereafter will occupy temporary offices in the banking rooms at the corner of Dearborn and Monroe streets. On October 1st., the Byllesby Company will remove to the banking rooms at present occupied by the Continental National Bank, to remain in that location until they return to the American Trust Building, June 1st, 1910.

CONTRACTS have been recently awarded to the New York Improved Equipment Company on bench construction account as follows: Ten benches of 6's (additional) for the Denver (Col.) works, full depth furnaces; 2 benches of 6's for the Beverly (Mass.) works; and one bench of 9's (this by way of a good, working experimental trial) fo-

the U. G. I. works at Point Breeze. All this bench work, of course, carries with it the Doherty fuel economizer system of construction.

At the special election held in Kirkwood, Mo., to determine whether or not the St. Louis County Gas Company should be granted a franchise for the distribution of gas in that territory for a period of 20 years, the total vote cast was 465, of which only 12 were in the negative. The price that the Company may charge on minimum account is $1.30 per 1,000 cubic feet.

Mr. C. J. R. Humphreys, agent of the Lawrence (Mass.) Gas Company, is busily engaged in putting the plant in order. Much construction work being necessary to fit it for the demands of the coming season. This construction concerns both the gas and electric divisions of the Company's apparatus.

If that grand old gas man, the late Mr. Benj. Harper, could know this, how well satisfied he would be over the prediction made within the hearing of the writer 30 years ago. He was at the time proprietor and President of the Rock Island Gas Light Company, having succeeded to the control formerly exercised by Mr. Frank R. Baby, the renowned General Agent of the Pacific Mail Steamship Company, when Mr. Comstock presided over the destinies of that important corporation. Mr. Harper said, "The sendout of the Rock Island Company to-day is less than 50,000 cubic feet, but the time will come when it will amount to not less than ½ million cubic feet in the 24 hours." This delving into the past was brought about through a squib, to hand the last week in July, from a correspondent in Rockford. The squib is this: "A new record of gas consumption for the twin cities—Moline and Rock Island, Ills.—was set Thursday, July 15th, when 600,000 cubic feet was used in a single day for lighting and cooking purposes in Moline and Rock Island."

Under the new agreement between the proprietors of the Mount Clemens (Mich.) Gas Company and the local authorities, it is virtually determined that the rate for gas shall not exceed $1.15 per 1,000 cubic feet, with a rebate of 15 cents per 1,000 when bills are settled within 15 days. It is further provided that when the annual output amounts to 75 million cubic feet the gross rate shall be $1.10 per 1,000, the net rate to be 95 cents. The Company will now extend its mains to and through the settlements on the East side of the river.

The Consolidated Gas Company, of this city, recently went into the market to borrow $5,000,000 wherewith to take up a loan similar in amount to one negotiated in 1908. The interest rate agreed on this year was 4 per cent.; that of a year ago was 5 per cent.

Some excellent specimens of tarvia pavement are to be found in the streets of Paterson, N. J. And the mention of Paterson brings to mind that the residents of two of its suburbs (Totowa and West Park) are loudly clamoring for a gas supply.

The plant and franchises of the Mount Clemens (Mich.) Gas Company have been purchased by the Kelsey-Brewer syndicate. This is a good property.

The Olds Gas Power Company, of Lansing, Mich., at its annual meeting, held the last week in July, increased its capital stock to $1,500,000, changed the title of the Company to that of the Seager Engine Works, and elected the following officers: President, J. H. Seager; Vice-President, F. S. Smith; Secretary and Treasurer, S. F. Seager; General Manager, Jas. B. Seager.

Mr. J. R. Bentley has resigned from the service of the Brooklyn Borough Gas Company, of Coney Island, N. Y., to undertake the management of the generating division of the Dallas (Tex.) Gas Company.

The Plymouth (Mass.) County Gas and Power Company proprietors have purchased several acres of land on Quincy avenue, Wymouth, whereon it is proposed later on to construct a modern gas plant.

Mr. E. F. Winton, of Davenport, Ia., is anxious to secure a franchise for the operation of a gas plant at Quanah, Tex. He represents the introducers of a system that is being peddled around by the Ideal Gas Lighting Company; and if Quanah is wise, it will have none of it.

The Pennsylvania Company for Insurances on Lives and Granting Annuities, as Trustee of the first mortgage, 5 per cent. gold bonds of the Savannah (Ga.) Gas Company, notifies the holders of the named security that, in accordance with the deed of trust, the following numbered bonds were drawn the 1st ult. for redemption: Nos. 65, 181, 246, 364, 407, 663, 827, 833, 857 and 1,044. The principal of said numbers will be paid at 105 and interest, on and after September 1st, next, after which date interest will cease.

Construction work, at least so far as breaking ground is concerned, was begun on the plant of the Nogales (Ariz.) gas works towards the close of last month. Cleveland parties are said to be the interested ones, but beyond this mention, which was narrated by a visitor to the office last week, we are unable to go.

A correspondent in Bloomfield, N J., writing under date of the 2d inst., says: "A Company is forming in Netcong and Stanhope, N. J., which has for its object the erection of a gas plant at some central location, and it is expected that an application for a franchise will be presented at the August meeting of the local Council."

The Quakertown (Pa.) Borough Council seems disinclined to grant a franchise to certain Philadelphia capitalists, under which they seek to construct and operate a gas works. The question, however will be settled towards the close of the month. The correspondent who furnishes this information seems to think the delay is traceable to certain ownership by those in power in a local electric lighting venture. He also says there is a great field for gas in and about Quakertown.

"V. S.," writing from Chester, Pa., under date of the 1st inst., says: "The Shoen-Jackson Company, whose large factory for the manufacture of flexible metallic tubing, located in Rose Valley, quite some distance out from Chester proper, has authorized the Suburban Gas Company to put down a main so the manufacturing concern may have a sufficient and dependable supply of gas for several large oven furnaces.

At the annual meeting of the Pittsfield (Mass.) Coal Gas Company these officers were elected: President, R. W. Adam; Secretary, W. L. Adam; Treasurer, H. A. Dunbar; Superintendent H. C. Crafts; Directors, T. F. Plunkitt, W. G. Backus, J. W. Hull, G. H. Tucker, W. L. Adam and R. W. Adam. That the meeting was thoroughly harmonious it can be easily understood when it is remembered that the records showed a gain in output for the twelvemonth figuring 18.7 per cent. That is doing pretty well; yea, very well.

Mr. John Patten has been appointed Manager of the Winonah (Wis.) gas plant. He managed the works at Holland City, Mich., since 1907. Both the named properties are owned by the Kelsey-Brewer syndicate.

Messrs. Chas. A. Smith, J. E. Madden and associates have applied to the authorities of Waseca, Wis., for the right to establish and operate a gas works in the named place.

W. A. Vincent, writing from Fresno, Cal., under date of July 28th, says: "Last week about thirty of Chico's (Cal.) business and professional men gathered in the Diamond Cafe to 'assist' in demolishing a farewell dinner tendered to M. W. Florence, formerly local manager of the Pacific Gas and Electric Company, who is booked for Fresno, Cal., the gas and electric plants of which place are hereafter to be under his direction."

Recent Boston advices are to this effect: "The Board of Gas and Electric Light Commissioners recently concluded a hearing, and on the petition of the Malden and Melrose Gas Light Company for the approval of the Board of an issue of additional stock to the amount of $230,600. Atty. A. B. Tenney appeared for the petitioner, and explained to the Board that the proceeds of this issue are intended to be used in part paying the floating debt of the Company, and the remainder is to be applied to the cost of permanent improvements in the Company's property. He stated that the stock is to be offered for sale at $140 per share, under the new law authorizing directors of gas companies to fix the price."

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHARLES H. WADELTON,
MANAGER.

MONDAY, AUGUST 9, 1909.

The Market for Gas Securities.

The gain for the week in the bid price for Consolidated is just 5 points, which will do as a starter; but unless all indications are to be taken in contrariety this movement is only the half turn to the initial starting impulse. Now that the tariff is out-of-the-way, and the fixing of the 80-cent rate has removed the Company for many years from the clutches of the legislators who make Albany a night mare with their presence, and the readjusting of the Company's capital is at hand, there can be only one outcome. The opening today (Friday) was 145 to 145½, with sales at 145⅝.

Brooklyn Union keeps good pace with Consolidated, the figures for it being 143 to 144. A subscriber asks us to find a purchaser for $6,000 at par of bonds (5½ per cent.), the loan having 18 years to run. We have no hesitation in saying the security is an altogether satisfactory one in investment account.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

AUGUST 9.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated Gas Co.	$78,177,000	100	145	145¼
Central Union Gas Co.—				
1st 5's, due 1972, J. & J.	3,000,000	1,000	98	101
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	—	105
Mutual Gas Co.	3,500,000	100	155	165
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	100	101½
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	—	100	101
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	104	107
Con. 5's, due 1945, J. & J.	1,500,000	—	97	101
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	94	100
Standard	5,000,000	100	—	75
Preferred	5,000,000	100	70	100
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	100	105
The Brooklyn Union	15,000,000	1,000	143	144
1st Con. 5's, due 1948, M. & N.	15,000,000	—	91¼	92
Yonkers	200,650	500	130	—
Out-of Town Companies.				
Bay State	50,000,000	50	1¼	1
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	65
" 1st Mtg. 5's	500,000	1,000	90	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
Bonds, 5's	5,250,000	1,000	73	73½
Capital, Sacramento	500,000	50	—	35
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,660,000	1,000	104	105¼
Cincinnati Gas and Electric Co.	20,500,000	100	92	93
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	96	98
Columbus (O.) Gas Lt. & Heating Co.	1,682,750	100	90½	91
Preferred	3,026,500	100	75½	80
Consumers, Toronto	2,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	—	105
Mortgages, 6's	3,600,000	—	—	118
Chesapeake, 1st 6's	1,000,000	—	—	—
Equitable, 1st 6's	910,000	—	—	—
Consolidated, 1st 5's	1,490,000	—	—	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	—	—	100
Denver Gas and Electric	458,000	—	102	105
Detroit City Gas Co	5,000,000	50	—	50
" Prior Lien 5's	4,619,000	1,000	97	100½
Detroit Gas Co., 5's	381,000	1,000	75	80
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	10
Essex and Hudson Gas Co.	6,500,000	—	39	40
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	—	112	113½
" Bonds, 5's	10,500,000	—	103	103½
Indianapolis	2,000,000	—	60	70
" Bonds, 5's	2,650,000	—	104½	105
Jackson Gas Co.	250,000	50	82	—
" 1st Mtg. 5's	200,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	—	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede Gas Co., St. Louis	10,000,000	100	104	105
Preferred	2,500,000	100	—	98
Bonds	10,000,000	1,000	104	—
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,370,000	50	143	145
Madison Gas and Electric Co.				
" 1st Mtg. 6's	350,000	1,000	106	108¾
" 6 per cent. scrip, due 1910	100,000	25	60	60½
Massachusetts Gas Companies, of Boston	25,000,000	100	64⅝	64⅞
Preferred	25,000,000	100	91	91½
Montreal Gas Co., Canada	2,000,000	100	218	218¾
Nashville Gas Light Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	56	58
Bonds, 6's	6,000,000	—	137	138
New Haven Gas Co.	2,000,000	25	200	—
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	115¾	116
1st Mortgage	20,100,000	1,000	—	—
2d "	2,500,000	1,000	104	—
Rochester Gas & Electric Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104½	105½
San Francisco Gas Co., Cal.	15,500,000	—	—	-
St. Joseph Gas Co.—				
1st Mtg. 5's	751,000	1,000	100	102
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgages, 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	90	95
Syracuse Gas Co., N. Y.	1,975,000	100	50	55
Bonds	2,047,000	1,000	100	101
Washington (D. C.) Gas Co.	2,600,000	20	377½	378¾
1st Mortgage, 6's	600,000	—	—	—
Western Gas Co., Milwaukee	4,000,000	—	—	—
Wilmington (Del.) Gas Co.	600,000	50	230	—

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As Superintendent,

By a competent gas man who has had practical experience in all branches of the business, both coal and water gas. At present employed. A-1 references.

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The Development of the Public Utilities Commissions as Applied to the Gas and Electric Business. C. J. Russell Humphreys.

A Half-Century's History of Gaseous Fuel as Applied to Heating Gas Retorts. F. Bredel.

Systems of Vertical Retorts. Fred. J. Mayer.

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Meters and Meter Makers. D. McDonald.

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Development of the New Business Division of the Gas Industry during the Last 50 Years. Philmer Eves.

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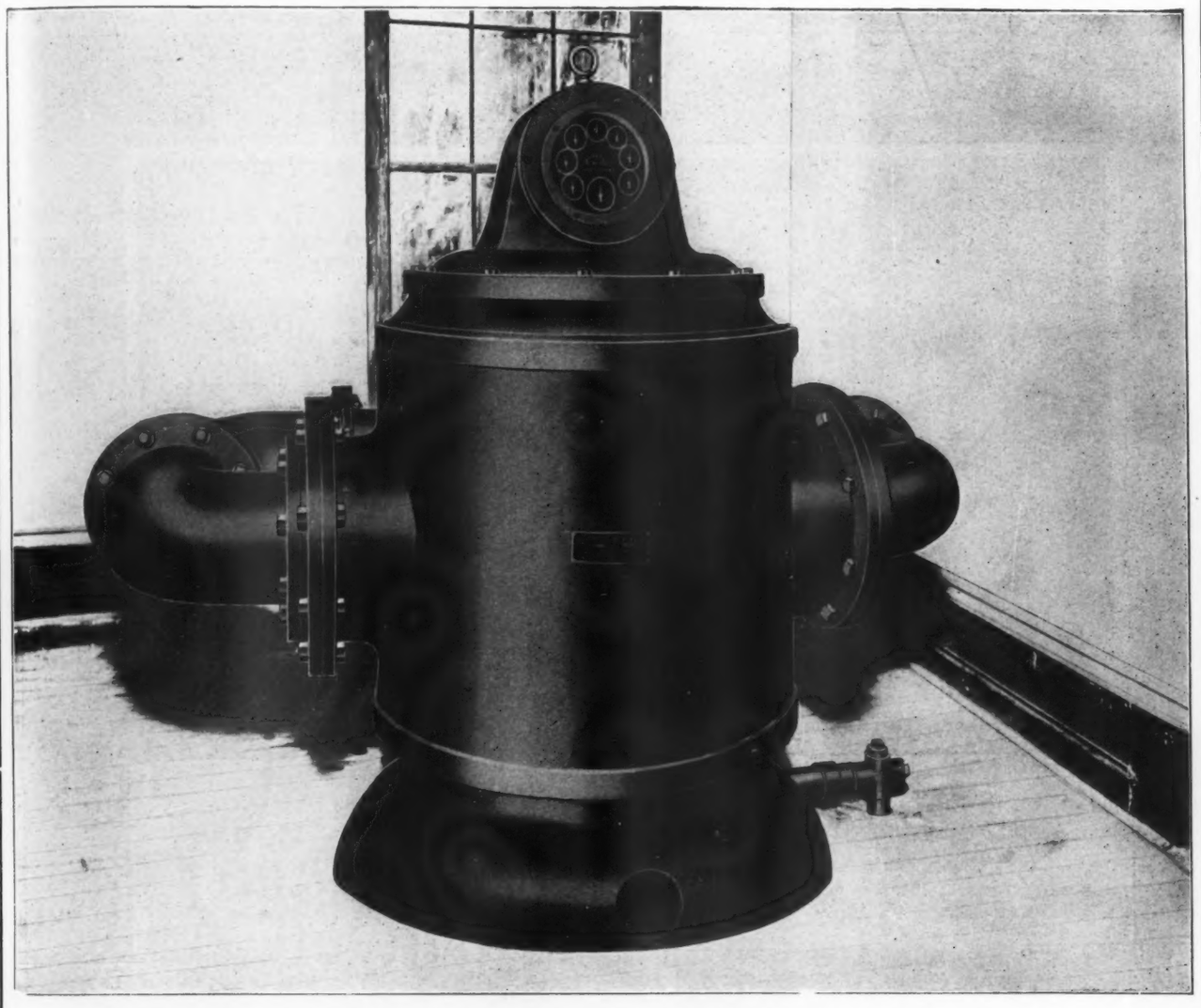

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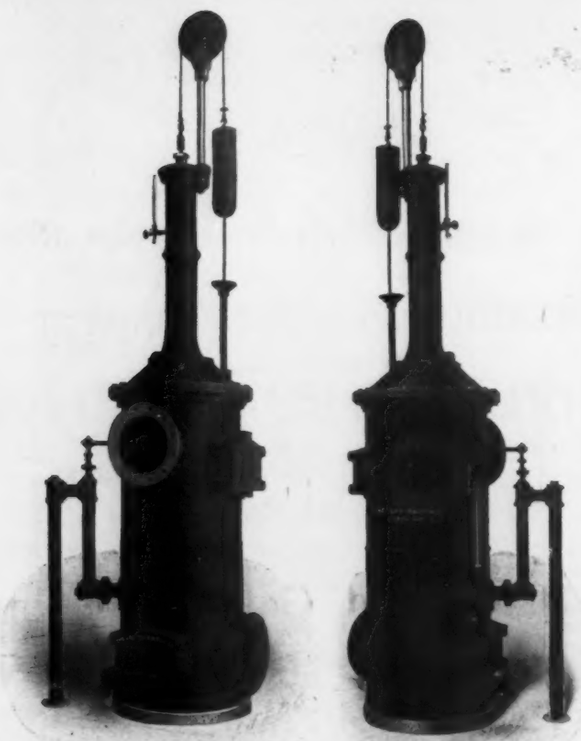

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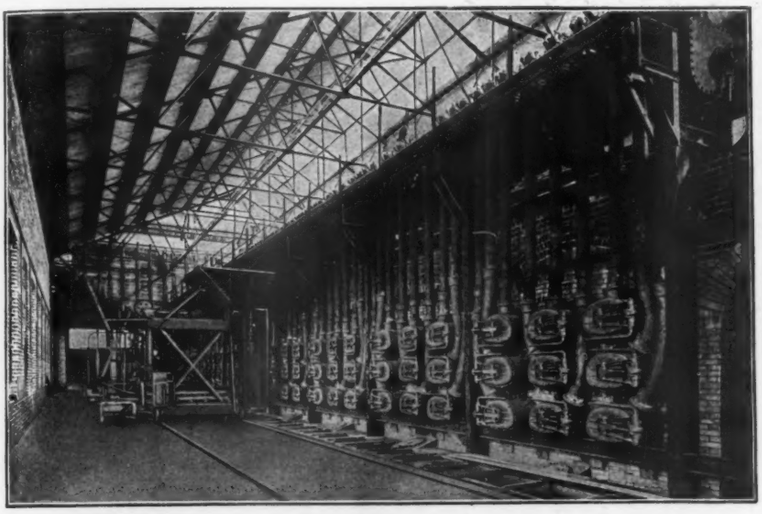

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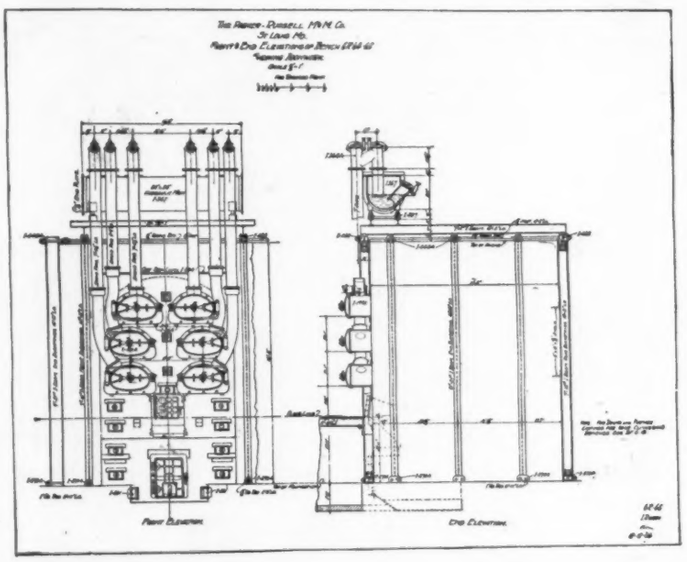

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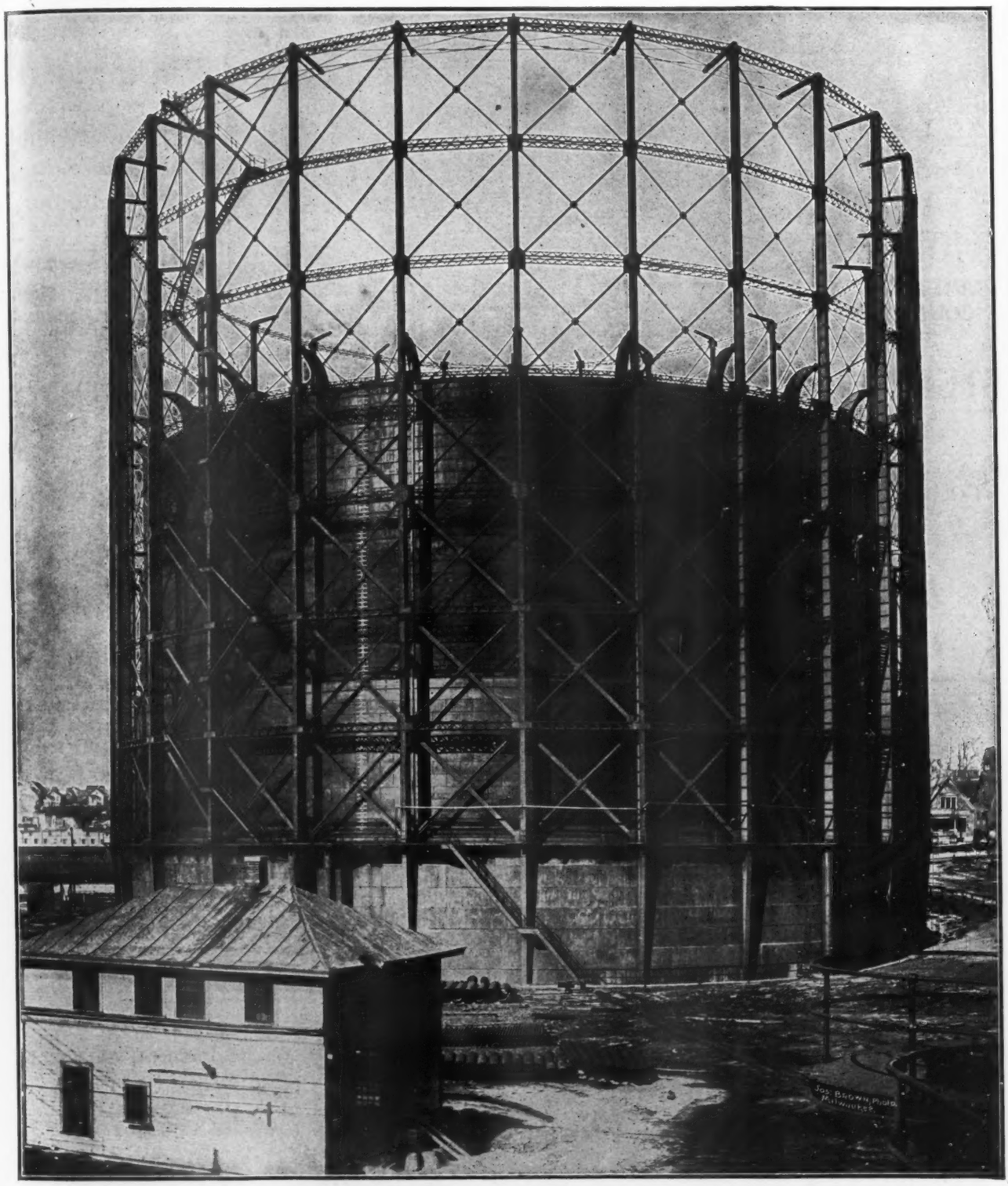

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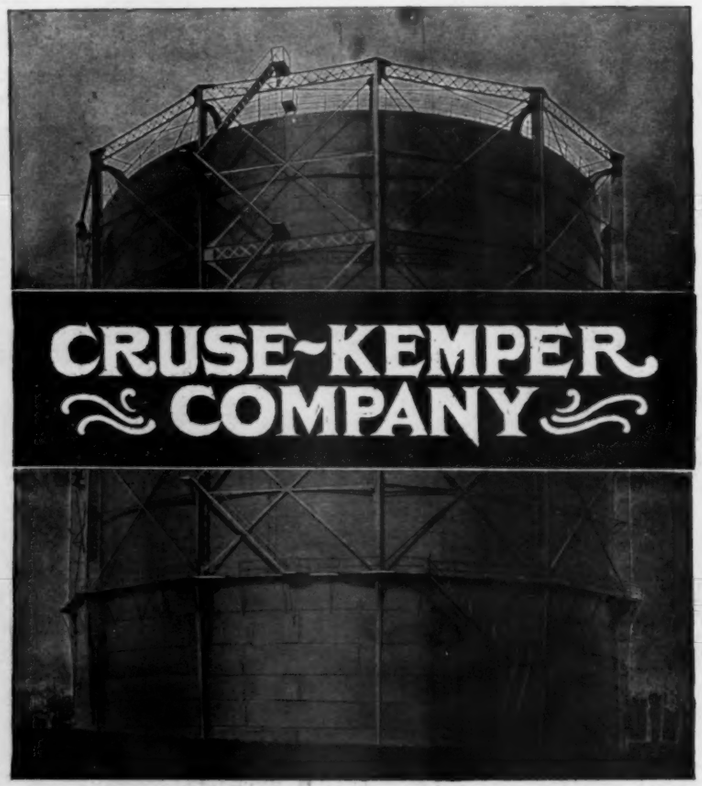

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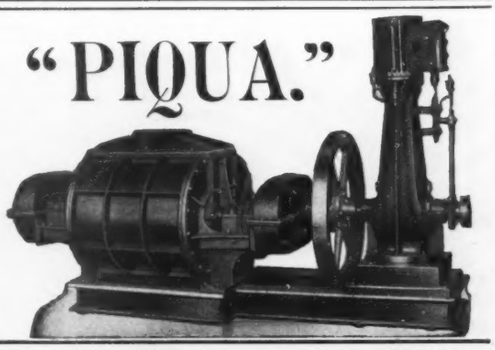

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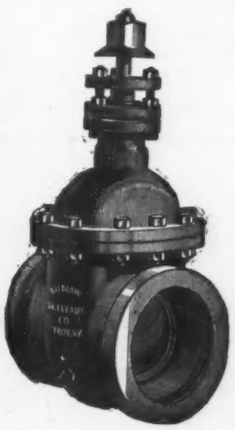

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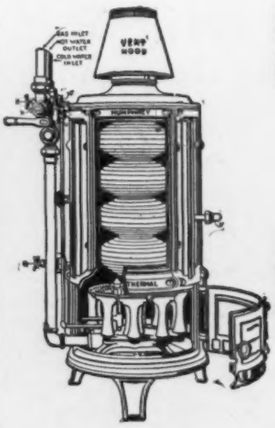

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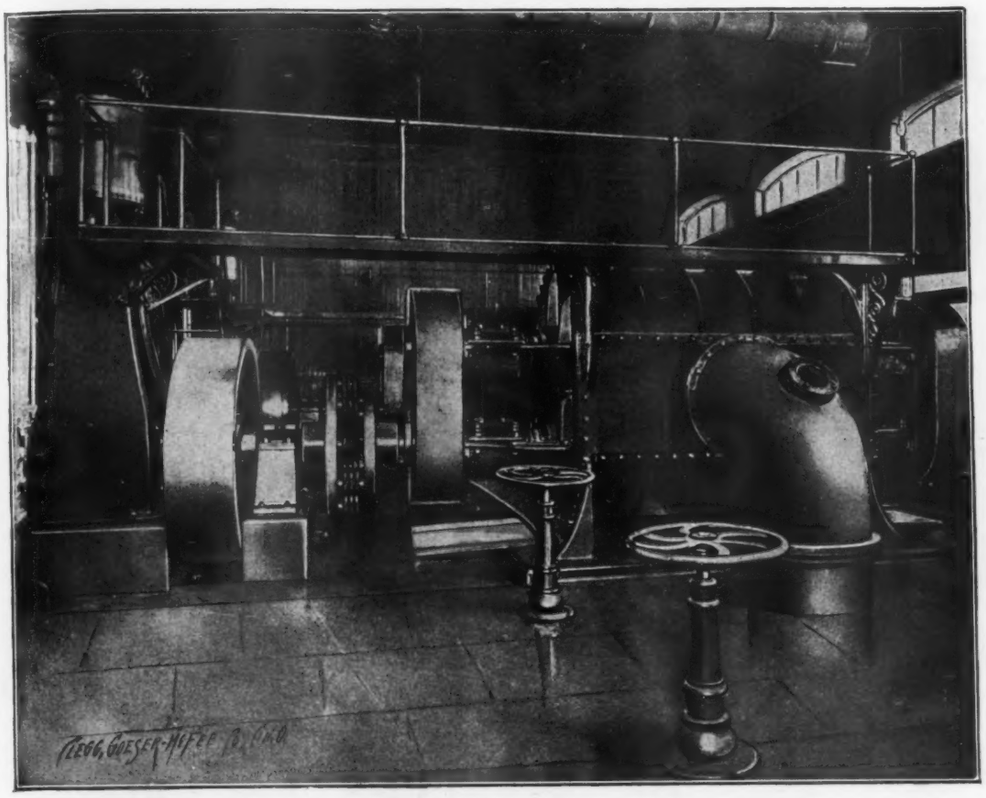

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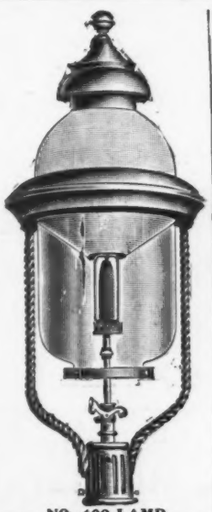

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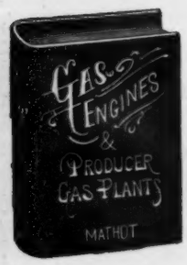

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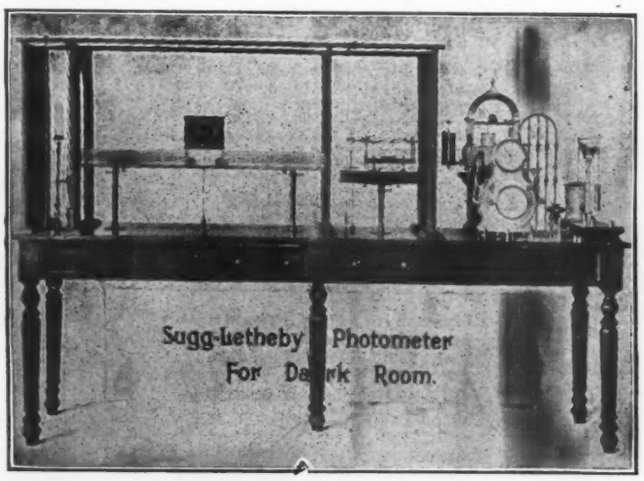
AUGUST, 1909.

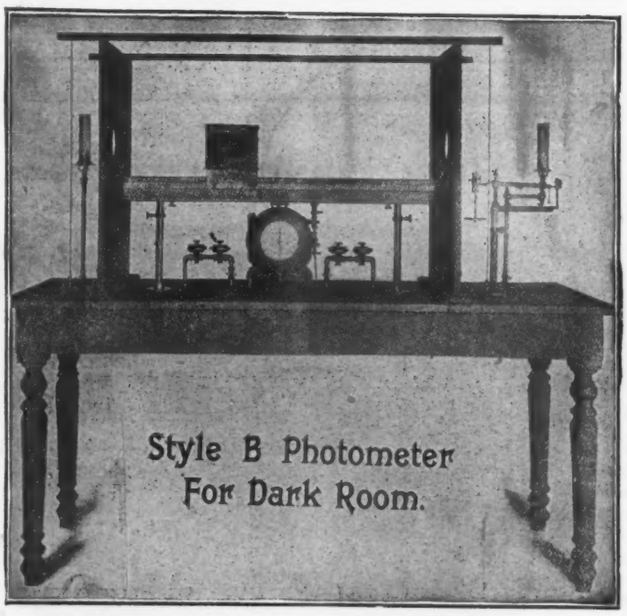
Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.
Sun.	1	No L FM	No L
Mon.	2	No L.	No L.
Tue.	3	7.40PM	9.50PM
Wed.	4	7.40	10.20
Thu.	5	7.40	10.50
Fri.	6	7.40	11.20
Sat.	7	7.40	11.50
Sun.	8	7.30LQ	12.20AM
Mon.	9	7.30	1.00
Tue.	10	7.30	1.40
Wed.	11	7.30	2.30
Thu.	12	7.30	4.10
Fri.	13	7.30	4.10
Sat.	14	7.30	4.10
Sun.	15	7.20NM	4.10
Mon.	16	7.20	4.10
Tue.	17	7.20	4.10
Wed.	18	7.20	4.10
Thu.	19	7.20	4.10
Fri.	20	8.20	4.10
Sat.	21	8.40	4.10
Sun.	22	9.10	4.20
Mon.	23	9.40FQ	4.20
Tue.	24	10.10	4.20
Wed.	25	11.00	4.20
Thu.	26	11.50	4.20
Fri.	27	12.50AM	4.20
Sat.	28	2.00	4.20
Sun.	29	No L.	No L.
Mon.	30	No L.FM	No L.
Tue.	31	No L.	No L.

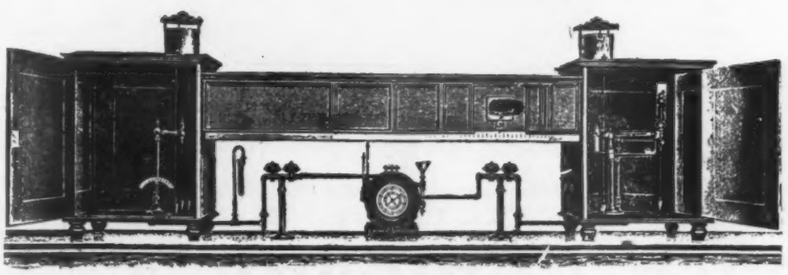
TOTAL HOURS DURING 1909.

By Table No. 1.

	Hrs.Min.
January	212.20
February	183.40
March	173.00
April	151.10
May	144.10
June	138.50
July	145.40
August	160.30
September	180.00
October	201.00
November	216.30
December	233.40
Total, yr.	2140.30







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PUBLIC LIGHTING TABLE.

AUGUST, 1909.

Day of Week.	Date.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Complete Lighting in One Hour From Time Given P. M.	Complete Extinguishing in 50 Minutes From Time Given A.M.
Sun.	1	7.02	3.27
Mon.	2	7.02	3.27
Tue.	3	7.02	3.27
Wed.	4	7.02	3.27
Thu.	5	7.02	3.27
Fri.	6	6.57	3.37
Sat.	7	6.57	3.37
Sun.	8	6.57	3.37
Mon.	9	6.57	3.37
Tue.	10	6.57	3.37
Wed.	11	6.57	3.37
Thu.	12	6.57	3.37
Fri.	13	6.47	3.47
Sat.	14	6.47	3.47
Sun.	15	6.47	3.47
Mon.	16	6.47	3.47
Tue.	17	6.47	3.47
Wed.	18	6.47	3.47
Thu.	19	6.47	3.47
Fri.	20	6.37	3.52
Sat.	21	6.37	3.52
Sun.	22	6.37	3.52
Mon.	23	6.37	3.52
Tue.	24	6.37	3.52
Wed.	25	6.37	3.52
Thu.	26	6.37	3.52
Fri.	27	6.27	3.57
Sat.	28	6.27	3.57
Sun.	29	6.27	3.57
Mon.	30	6.27	3.57
Tue.	31	6.27	3.57

TOTAL HOURS DURING 1909.

	Hrs.Min.
January	428.30
February	358.15
March	353.10
April	298.10
May	263.20
June	234.45
July	248.30
August	278.00
September	311.25
October	370.05
November	397.40
December	438.35
	3980.25
Deduct on account of 50 min. extinguishing time	30.25
Total, yr.	3950.00

NEW YORK, 318 West 42d Street.
BOSTON, 820 Beacon Building.
PHILADELPHIA, Broad and Arch Streets.
ST. LOUIS, 712 Roe Building.
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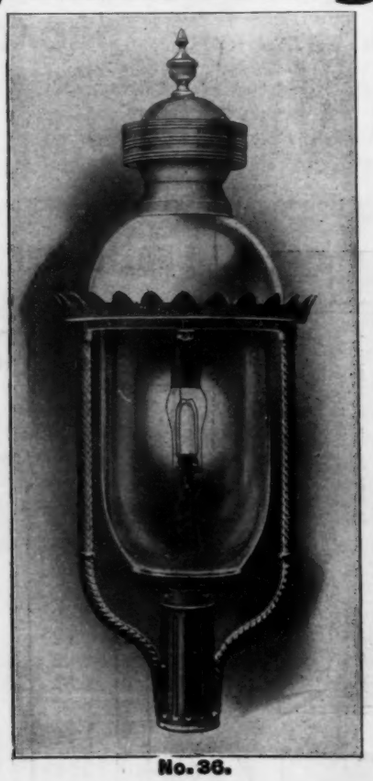
WELSBACH STREET LIGHTING COMPANY



No. 36.

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IT LIGHTS THE STREET.

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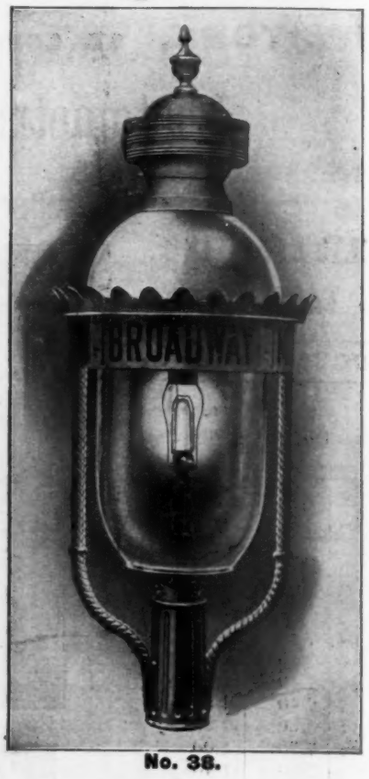

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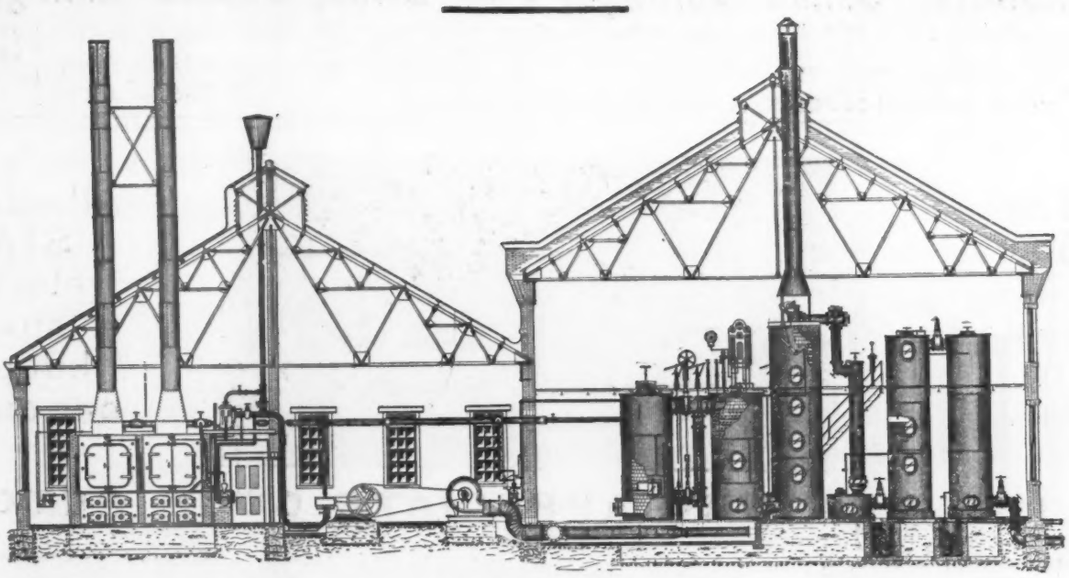

TOTAL SETS INSTALLED TO JULY 1, 1909, ... 704
TOTAL DAILY CAPACITY TO JULY 1, 1909, ... 577,440,000 cu. ft.

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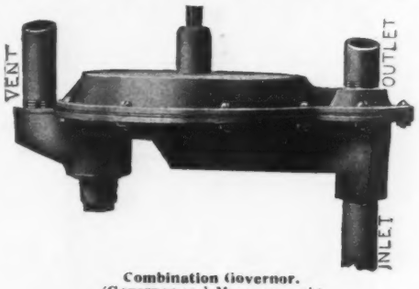

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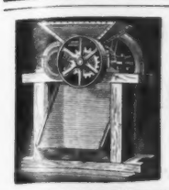

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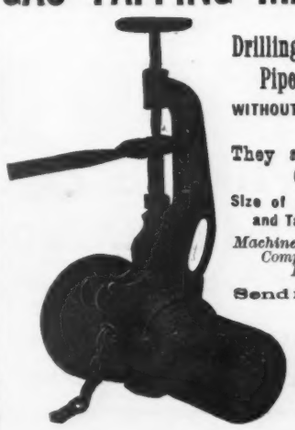

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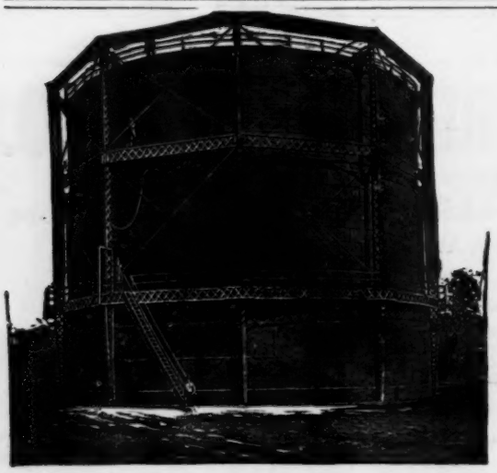

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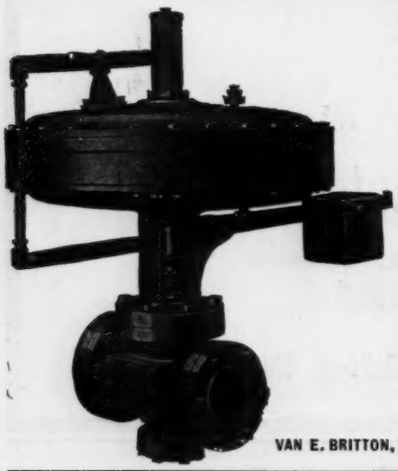

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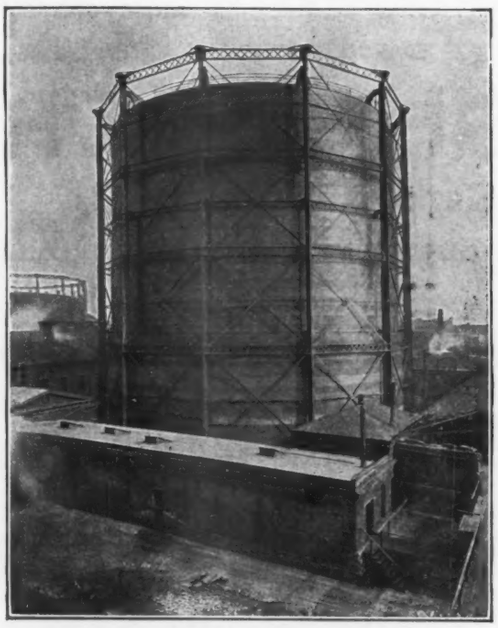

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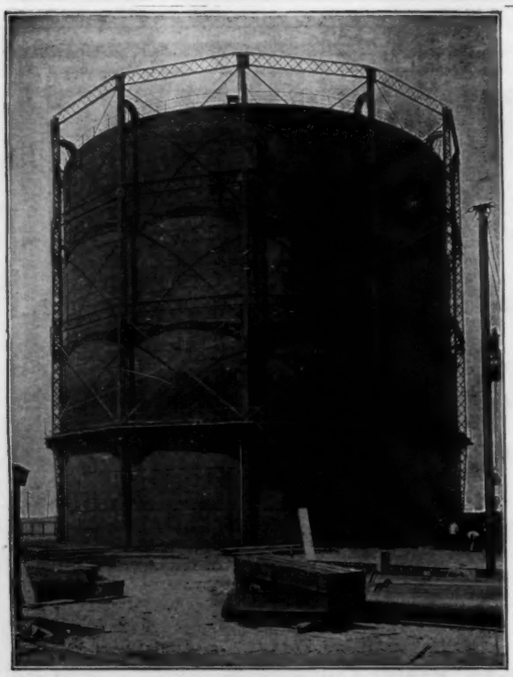

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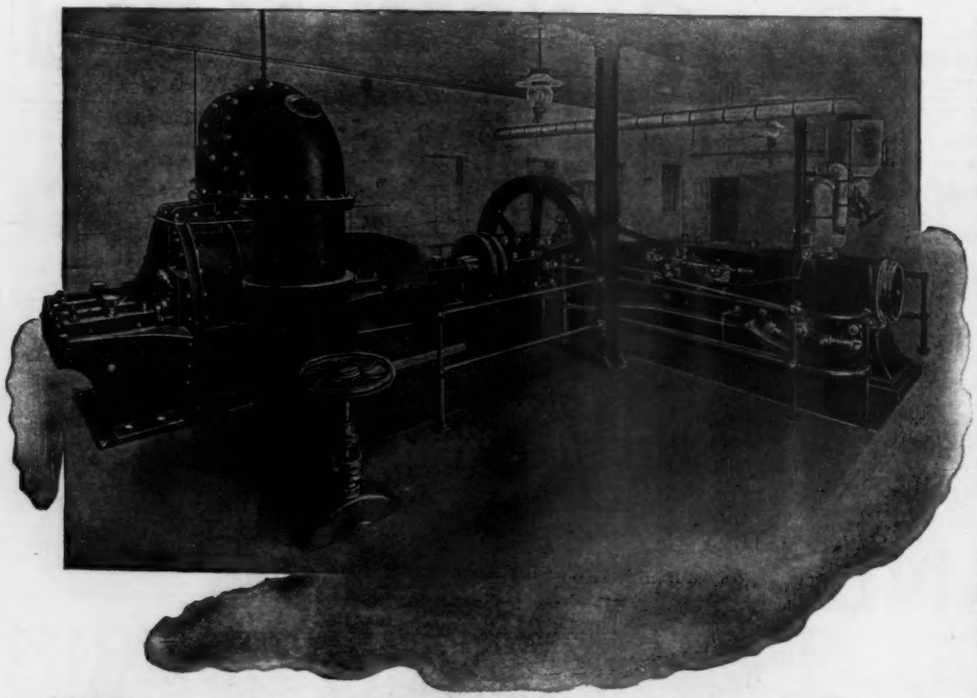

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